Province of British Columbia
Ministry of Agriculture and Food
Government of Canada
Gouvernement du Canada
Agriculture Canada

OPPORTUNITIES FOR NUT CROPS IN THE OKANAGAN, KOOTENAYS, AI) SOUTH COASTAL AREAS OF BRITISH COLUMBIA

Project Number 271322, Subproject 6

Under

CANADA-BRITISH COLUMBIA SUBSIDIARY AGREEMENT

ON AGRICULTURE AND RURAL DEVELOPMENT

Prepared by:

ARDCORP
B.C. AGRICULTURAL RESEARCH & DEVELOPMENT CORPORATION
846 BROUGHTON STREET
VICTORIA, B.C. V8W 1E4

OCTOBER 1984

Province of British Columbia

Ministry of Agriculture and Food

Government of Canada / Gouvernement du Canada

Agriculture Canada

OPPORTUNITIES FOR NUT CROPS IN THE OKANAGAN, KOOTENAYS, AND SOUTH COASTAL AREAS OF B.C.

Project Number 271322, Subproject 6

UNDER

CANADA - BRITISH COLUMBIA SUBSIDIARY AGREEMENT

ON AGRICULTURE AND RURAL DEVELOPMENT

Prepared by:

ARDCORP
B.C. AGRICULTURAL RESEARCH & DEVELOPMENT CORPORATION
846 BROUGHTON STREET
VICTORIA, B.C. V8W 1E4

OCTOBER 1984

Canadian Cataloguing in Publication Data

Main entry under title:
Opportunities for nut crops in the Okanagan, Kootenays, and south coastal areas of B.C.

Co-published by Agriculture Canada.
"Project number 271322, Subproject 6 under Canada - British Columbia Subsidiary Agreement on Agriculture and Rural Development."
Bibliography: p.
ISBN 0-7726-0262-X

1. Nuts - British Columbia. 2. Filbert - British Columbia. 3. Walnut - British Columbia. 4. Chestnut - British Columbia. I. ARDCORP. II. British Columbia. Ministry of Agriculture and Food. III. Canada. Agriculture Canada. IV. Agriculture and Rural Development Subsidiary Agreement (Canada)

HD9259.N7C33 1985 338.1'745 C85-092088-4

OPPORTUNITIES FOR NUT CROPS IN THE OKANAGAN KOOTENAYS AND SOUTH COASTAL AREAS OF B.C.

I N D E X

PAGE

ACKNOWLEDGEMENTS..... 1

EXECUTIVE SUMMARY..... 2

INTRODUCTION..... 5

PERSPECTIVE ON FILBERTS, WALNUTS AND SWEET CHESTNUTS..... 7

HISTORY AND PRESENT STATE OF NUT PRODUCTION IN B.C.....11

RESEARCH AND EXTENSION PROGRAMS ON TREE NUTS.....17

OVERVIEW OF OREGON AND WASHINGTON NUT INDUSTRIES.....18

B.C. AREAS SUITABLE FOR PRODUCTION.....23

- South Coastal.....25
- Okanagan-Similkameen.....29
- Kootenays.....31

PRODUCTION REQUIREMENTS FOR TREE NUTS.....32

HARVEST AND STORAGE REQUIREMENTS.....35

POTENTIAL CONSTRAINTS TO PRODUCTION.....37

PROCESSING AND DRYING FACILITIES.....42

QUALITY OF PRODUCT.....49

MARKETING.....52

POTENTIAL CONSTRAINTS TO MARKETING.....60

COST OF PRODUCTION.....61

SUMMARY AND CONCLUSIONS.....6[illegible]

REFERENCES.....68

COST OF ESTABLISHING AND CARRYING A FILBERT ORCHARD ORCHARD TO FULL PRODUCTION.....Appendix A

COST OF ESTABLISHING AND CARRYING A WALNUT ORCHARD TO FULL PRODUCTION.....Appendix B

ACKNOWLEDGEMENTS

This study was funded by a grant from the Research, Planning, Training and Market Promotion program of the Canada-British Columbia Agriculture and Rural Development Subsidiary Agreement. The Agreement, which provides a variety of programs for Agriculture and Rural Development, is cost shared equally by the governments of Canada and British Columbia through Agriculture Canada and the Ministry of Agriculture and Food, respectively. Programs under the Agreement are administered by the Ministry of Agriculture and Food and managed by a joint Federal/Provincial committee.

The responsibility for the report as written and all conclusions reached herein, is the consultants' alone, and does not necessarily reflect the opinions of those who assisted during the course of this investigation and the Federal and Provincial governments which funded the study.

The author wishes to thank Mr. W.S. Peters, Provincial Nut Specialist, for his assistance in providing background information on the horticultural aspects of this report, and Mr. Bill Garcia for his work on the Cost of Production Models. The efforts of Mr. J. Alcock, BCMAF Marketing Branch, in providing information on the marketing aspects are also appreciated. Special thanks also go to Mr. Robert Stebbins of Oregon State University for providing insights into the Oregon nut industry and to Dr. M.F. Welsh for Okanagan information.

British Columbia and Oregon filbert growers and buyers were most cooperative in providing information during the course of this study. Their help is much appreciated.

EXECUTIVE SUMMARY

Although tree nuts have been grown in British Columbia for many years, they have not been fully assessed for the potential they may hold for increased commercial production. The present crop of B.C. grown filberts fills only a fraction of the available Canadian market. There are no commercial walnut or sweet chestnut plantings in the province.

Periodic winter freezes and ice storms have killed or injured nut trees in all parts of the province, walnuts having been more severely affected than filberts and chestnuts. Spring frost has also taken its toll on early-flowering nut trees.

Climate in the south coastal area has proved more hospitable to tree nuts than in the Okanagan and Kootenays. There is opportunity for expansion, especially for filberts, in the Fraser Valley and on Vancouver Island. Limited commercial trials of carefully selected hardy walnut and filbert varieties appear worthwhile for Interior districts.

Although the province maintains a strong extension program on tree nuts, there is a need for research on these crops, particularly on variety breeding and selection.

Oregon State, with 22,000 acres, grows nearly all the filberts produced in the U.S. California grows nearly all the walnuts, this crop having been largely abandoned by Pacific Northwest growers owing to low yields.

There are plenty of soils in all of the study areas which are suitable for tree nuts, but high land values are a constraint in some districts. Production requirements for filberts are easily met in the south coastal district, but climatic constraints raise questions about their suitability in interior districts. Walnuts remain a questionable enterprise at least until reliably hardy, more

productive varieties have been demonstrated.

The main constraints to nut production are the long time required for trees to reach full bearing, winter and spring frost damage to crops, winter freeze damage to trees, and high investment cost in land, buildings, machinery and equipment.

Tree nuts as an enterprise can be fully mechanized, a factor which holds appeal for full time and part time operators alike. There is very little requirement for hired labour.

Modest expansion of B.C. filbert tonnage could be accommodated by existing drying facilities. If, however, the tonnage were to increase to more than double the present 300 ton volume, additional drying and storage facilities would have to be built.

Nut buyers are generally satisfied with the quality of B.C. grown filberts, and would welcome increased local production. Buyers agree however, that B.C. cannot compete with California for the available walnut business. At present there is no formal marketing organization for nut crops in B.C.

Although startup costs for a nut orchard are quite high, it is apparent that a filbert orchard can be expected to yield a small return to operator labour, management and land investment by the seventh year. When in full bearing at 12 years of age, a 60 acre orchard in the south coastal area is seen to realize a gross return of $1600 and a $985 return to operator labour, management and land investment. However, when the money invested during development years is discounted at 10% and an interest rate of 12% is applied on this money, the investment is much less attractive.

In the Okanagan and Kootenays, cost of production is slightly higher and returns lower owing mainly to the necessity for irrigation.

Walnuts as an enterprise are much less attractive than filberts. Not until the 13th year is there sufficient return from a 30 acre orchard to realize any return on the operator's investment. The main problem is low yield. When the discounted cash flow method is applied over a 30 year period, this walnut orchard presents a very negative picture.

Trade statistics suggest that an additional 700 to 800 acres of filberts would be required to replace the current volume of imported unshelled hazelnuts entering Canada. It is with the unshelled product that the best opportunity for import replacement exists at the present time. New easy-blanching varieties or a research breakthrough in blanching existing varieties would allow B.C. growers access to the large kernel market as well.

INTRODUCTION

Tree nuts have been grown in British Columbia for many years, but have not been fully assessed for the potential they may hold for increased commercial production.

At the present time, there are more than 600 acres of filberts in commercial production in the Lower Fraser Valley. However, the production coming from these trees fills only a very small fraction of the demand for hazelnuts in Canada.

There are no commercial walnut or sweet chestnut plantings in the province at present, although small lots of both have been planted from time to time over the past seventy years.

Interest has recently been expressed by several landowners in tree nuts as a commercial venture. This report attempts to evaluate the opportunities which may exist for increasing commercial production.

Included in the report is a history of nut growing in the province together with a description of the present state of the B.C. industry. Historical records of production and returns are presented.

Three specific areas of the province are examined for horticultural suitability - South Coastal, Okanagan, and Kootenay areas.

The report covers three main types of tree nuts - filberts, walnuts, and sweet chestnuts, with major attention being given to filberts which have comprised a small commercial industry in the province for the past 40 years.

Specific attention is given to both the horticultural feasibility and economic feasibility of growing these crops. Costs involved in establishing and maintaining a 60 acre filbert orchard are developed in detail. Similar costs for a 30 acre walnut orchard are also presented. Summary pages on the discounted cash flow principle are included.

Since all tree nuts must be processed and dried following harvest, the cost of establishing and maintaining a processing line and drying plant is developed for both an on-farm facility and a cooperative plant. The cost of operating an on-farm cleaning and drying plant is outlined.

During the course of this study, contact was made with many individuals and agencies who have knowledge of one or more facets of the nut industry. Interviews were held with producers, extension and research personnel, University staff, provincial Marketing Branch staff, economists, federal food production and inspection officials, and members of the buying trade. The Oregon filbert industry was also examined for insight into its infrastructure as well as its production and marketing experience.

Production requirements for tree nuts as well as the constraints to both production and marketing of the finished product are detailed.

PERSPECTIVE ON FILBERTS, WALNUTS AND SWEET CHESTNUTS

Generally speaking, nut trees reach full bearing habit slowly but live and produce crops for a long time. It is known that trees of the filbert, walnut and sweet chestnut sometimes continue to produce nuts a hundred years or more after planting. British Columbia's experience with tree nuts is relatively short in terms of world experience, but even so there are filbert, chestnut and walnut trees in excess of 50 years of age producing crops annually in the more temperate areas of this province. This is not to say that all such trees that have been planted are still going strong. They are not. Periodic natural hazards such as low winter temperatures and ice storms have taken a heavy toll on trees, but many have survived with varying degrees of thriftiness. Subdivision of farmland has also eliminated some tree nut acreage.

Filberts

Filberts constitute about 20% of world production of all tree nuts. Although there are several species of filberts (hazelnuts) which are native to British Columbia, the large-fruited varieties which are suitable for commercial production in the Pacific Northwest have all been developed from European sources. Turkey has been exporting hazelnuts for over 500 years and continues to be the world's largest producer at about 250,000 tons. Second is Italy with 97,000 tons. France is said to be planting filberts heavily. Even though the United States is a very small producer in world terms with about 16,000 tons, hazelnuts from Oregon orchards dominate the B.C. and western Canada in-shell market. In the U.S., filberts are grown commercially only on the western slopes of the Cascade Mountains in Oregon and Washington, with Oregon producing close to 90% of the total tonnage. B.C. currently produces about 300 tons annually. California and the Eastern States are too warm in summer for successful hazelnut production and

have other constraints as well.

Breakdown by age of the British Columbia acreage shows that 250 acres are 30 years and older, the other 450 acres being 15 years and younger. Of this latter, 150 acres are 3 years and younger.

In B.C., filberts are nearly always grown as multiple-stem trees which produce a few nuts in their third or fourth year. Well-grown trees reach full bearing habit at 12 years.

Cross pollination is an essential element of successful filbert production. It is therefore necessary to have two or more compatible varieties in the orchard. Pollination occurs during January, February and March, but actual fertilization occurs in June.

Hazelnuts grow in clusters on one year wood. The husks are thin, having a leaf-like covering with a fringed outer edge. With some varieties, the husks open as the nuts mature, allowing the nuts to drop to the ground. But with Duchilly, the predominant variety in B.C., this separation process occurs with difficulty and special procedures are required to encourage separation.

Walnuts

The so-called English walnut, which is the main walnut of commerce, is said to have originated in Persia more than 2000 years ago. For this reason, it is also called the Persian walnut by some authorities. Spanish missionaries first brought walnuts to California in the 1700's and by the 1800's a walnut industry had been established. Today, the leading world producer of English walnuts is

the United States, producing about 200,000 tons annually. Virtually all of this crop is grown in California, other producing states in the U.S. having largely abandoned commercial walnut production. Other world producers are France, Italy and the People's Republic of China. B.C. has no measurable commercial production at the present time. The numerous walnut trees on farmsteads and home lots produce nuts for home use and sometimes for local sales.

Walnuts are grown as single stem trees which often produce a few nuts at five or six years of age. They normally reach full bearing capacity after 20 years and remain productive almost indefinitely thereafter. Mature walnut trees reach immense stature, often spreading to a diameter of 70 feet and a height of 40 feet, The trees are self-fertile but usually produce larger crops when cross-pollination is provided. With the hardy late-leafing varieties, pollination occurs in April & May.

The nuts are borne in clusters on one-year wood, a husk covering the shell of each nut. As the walnuts ripen, the husks open, and the nuts fall to the ground. Commercially, the trees are mechanically shaken and the nuts mechanically harvested, dehulled, washed, dried and bleached.

Sweet Chestnuts

Sweet chestnuts are said to be the greatest tree-food crop of the world, owing to their importance as food in Southern Europe, China and Japan. In those countries, the nuts are eaten fresh, boiled, roasted or as flour and are also fed to poultry and farm animals.

Magnificent native chestnut forests once stood in North America and were prized by the pioneers, but between 1900 and 1940, chestnut blight, thought to have

come from the Orient, destroyed most of these trees. For this reason, only the Chinese (Castanea molissima) or the Japanese (C. crenata) varieties should be considered for planting.

International trade in sweet chestnuts is not reported by Canadian trade authorities, but it is known that North America imports between 5000 and 6000 tons annually from Europe.

There is no commercial production of this crop in B.C. or in the Pacific Northwest at the present time. There are, however, numerous sweet chestnut trees growing on farmsteads in the Fraser Valley. There is also one fairly extensive sweet chestnut grove on the banks of the Fraser River adjacent to Errock Lake which must have been in place since the early 1900's and is producing chestnuts annually on trees over 100 feet high. It is noted that these chestnut trees are extremely aggressive, having crowded out native broad leaf maples and other species so that the grove is totally one of sweet chestnuts.

Chestnuts grow as single stem trees and often produce a few nuts at five or six years of age. They are beautiful ornamental trees and tend to dominate and shade out other species. They are very clean trees seemingly unaffected by pests and diseases. The trees, which bloom later than walnuts and are therefore less susceptible to spring frost, require cross pollination for best results. The beautiful brown-coloured nuts grow within a green burr covered with bristles. Each burr contains two or three thin-shelled nuts. When the nuts are ripe, the burrs break open and the nuts are easily shelled, although they must usually be shaken from the trees. Harvest of sweet chestnuts is difficult as spoilage of the nuts occurs quickly if they are not gathered regularly as they fall and treated with fungicide. They must be quickly dried to bring the moisture content down to 9% and stored under cool conditions.

HISTORY AND PRESENT STATE OF NUT PRODUCTION IN B.C.

Reference data on early tree nut production in British Columbia is scant. Probably the best chronological reference on this subject was developed by W.S. Peters of Abbotsford, the provincial government tree nut specialist. Other information has been obtained through personal observation and discussion with knowledgeable individuals.

Walnuts appear to have been the first nut trees planted in the province, numerous plantings having been made in the Chilliwack area prior to 1920. For some years they were used as both orchard and boulevard trees in that area and are said to have been quite productive. By 1930, walnuts, sweet chestnuts, and filberts were being planted in small lots in the Fraser Valley and on southern Vancouver Island. A 1936 orchard survey recorded 90 acres of walnuts in the Chilliwack area but this acreage was not shown on subsequent surveys. It is known that the famous Chilliwack "Silver Thaw" of 1936-37 wreaked havoc with walnut trees and it is probable that many trees disappeared at that time. Subsequent ice storms in the area have taken periodic tolls on walnut trees and to some extent on filbert trees. In addition, it is recorded that the severe 1949-50 winter which devastated interior tree fruit orchards also killed many walnut trees. Further widespread destruction of trees occurred in the November 1955 freeze. From 1930 onward, the recorded history has been almost totally one describing development of the filbert industry.

By 1938, filberts were considered a commercial crop, with 79 acres recorded, one-third of these on Vancouver Island and the remainder in the lower Fraser Valley. By 1940, filbert acreage had increased to 116 acres, and four years later, to 313 acres, of which 90% were located in the Fraser Valley, the balance being on Vancouver Island.

Nut prices were good at that time and the fledgling industry was attracting a good deal of interest. B.C. filbert production in 1945 was estimated at 90,000 lbs. It was in 1945 that the most noteworthy pioneer of nut culture in this province, Mr. J.U. Gellatly of Westbank, developed a tree nut nursery and commenced a breeding and selection program for improved and hardy varieties of soft-shelled walnuts, filberts, and several other types of tree nuts. He and his sons were successful in introducing several hardy selections suited to B.C. climatic conditions and have received world recognition for their excellent work. William J. Childgen of Loomis Washington has introduced the hardy Cascade and Chopaka varieties of walnuts which appear to hold promise for the Okanagan and Kootenay areas.

North Americans have accomplished a great deal in breeding and selecting superior varieties of European and native tree nuts for improved production, hardiness and disease resistance. Nurserymen have developed new and improved methods of propagation for slow growing and difficult trees.

By 1947, the filbert crop had increased to 200,000 pounds which glutted the available market and resulted in low prices. It was in 1945 that the British Columbia Nut Growers Association was formed with C.A. Skelton as President. In 1950 the Association joined the Canadian Federation of Agriculture with 39 registered growers, 514 acres, and 60,720 filbert trees.

During the 40's and 50's, B.C. filbert growers developed a good rapport with growers in Oregon and Washington whose industry was developing at a substantial pace. By 1951 C.A. Skelton was elected Vice-President of the Nut Growers Society of Oregon and Washington, as it was then called. B.C. growers began to attend field days in Oregon about this time, and in 1953 Mr. Skelton became the only Canadian ever to be elected as President of the N.G.S.O.W. Subsequently, the organization has been re-named the Nut Growers' Society of Oregon Washington and British Columbia.

By 1954, with a crop of 600,000 pounds, growers began to acquire equipment for harvesting, washing and drying their filberts. A disastrous freeze on November 11, 1955 caused substantial damage to some filbert orchards and wiped out many walnut trees which had been planted in earlier years in coastal and interior valley locations, including the experimental trees at the Agassiz Research Station. No serious attempts at walnut production have been made since that time. Filbert yields fluctuated throughout the 1960's at levels between 200,000 and 300,000 lbs. In 1971, the crop dropped to 110,000 lbs. due to severe ice storm damage the previous winter. By 1976, only 340 acres were recorded in filbert production. This has gradually increased during the past eight years to the present level of over 600 acres with an annual production of about 300 tons. Yield and price statistics on the B.C. filbert crop are outlined in Table 1.

In spite of periodic setbacks from ice storms and winter freezes, some varieties of walnuts are obviously thriving in both the Fraser Valley and to a lesser extent the Okanagan and Kootenays. It is true that some of the standing trees look sick, but others are big healthy-looking trees which have stood the test of time. Obviously, variety is a most important consideration with walnuts in the various regions of the province. Variety records have not been well kept, however, and since local research on varietal suitability is lacking, it is difficult to determine which varieties have survived over time. It is significant to note that walnut trees in the Coastal Area are carrying a very light crop in 1984. Cascade, Chopaka and Broadview are carrying good crops in the Interior and appear to have sufficient hardiness to merit commercial trial in the 3 study areas.

At the present time, the only truly commercial plantings of tree nuts in B.C. are the filbert plantings in the Fraser Valley. There are a very few small walnut and filbert groves in the south and central Okanagan and many home garden and farmstead trees planted for home use. The Creston Valley has a few walnut trees planted in the fruit orchards which are reported to bear quite well at times.

TABLE 1

BRITISH COLUMBIA FILBERT PRODUCTION STATISTICS - 1961-1983

YEAR	FRESH WHOLESALE QUANTITY (lbs.)	PRICE PER POUND	FRESH WHOLESALE VALUE $	FRESH FARM SALES (lbs.)	PRICE PER POUND	FRESH FARM VALUE	TOTAL SALES (lbs.)	TOTAL VALUE $
1961	303,000	.284	$86,110	No Farm Sales Reported			303,000	$86,110
1962	266,500	.304	81,016	"	"	"	266,500	81,106
1963	199,000	.299	59,501	"	"	"	199,000	59,501
1964	141,500	.317	44,856	"	"	"	141,500	44,856
1965	220,000	.3384	74,440	"	"	"	220,000	74,440
1966	356,000	.3098	110,300	"	"	"	356,000	110,300
1967	180,000	.3292	59,250	"	"	"	180,000	59,250
1968	261,700	.2804	73,376	"	"	"	261,700	73,376
1969	215,000	.35	75,250	"	"	"	215,000	75,250
1970	273,000	.35	95,550	"	"	"	273,000	95,550
1971	110,000	.35	38,500	"	"	"	110,000	38,500
1972	300,000	.37	111,000	"	"	"	300,000	111,000
1973	340,000	.40	136,000	"	"	"	340,000	136,000
1974	270,000	.39	81,000	6,000	.25	$1500	276,000	82,500
1975	309.000	.46	142,140	36,000	.25	9000	345,000	151,140

BRITISH COLUMBIA FILBERT PRODUCTION STATISTICS - 1961-1983

YEAR	FRESH WHOLESALE QUANTITY (lbs.)	PRICE PER POUND	FRESH WHOLESALE VALUE $	FRESH FARM SALES (lbs.)	PRICE PER POUND	FRESH FARM VALUE	TOTAL SALES (lbs.)	TOTAL VALUE $
		.45						
1976	444,000	.45	$199,800	36,000	.25	$ 9,000	480,000	$208,800
1977	500,000	.53	265,000	40,000	.25	10,000	540,000	275,000
1978	500,000	.53	265,000	40,000	.37½	15,000	540,000	280,000
1979	560,000	.55	308,000	40,000	.40	16,000	600,000	324,000
1980	525,000	.80	420,000	25,000	.56	14,000	550,000	434,000
1981	310,000	.81	251,100	20,000	.60	12,000	330,000	263,100
1982	500,000	.73	365,000	22,000	.80	17,600	522,000	382,600
1983	390,000	.75	292,500	25,000	.85	21,250	415,000	313,750

Source: Horticultural Production and Value Statistics
B.C. Ministry of Agriculture and Food.

Filberts in the Kootenays have been damaged by snowload and deer. One small block of walnuts at Rosemont has been recorded as having yielded satisfactorily. Nut acreage on Vancouver Island has virtually disappeared through subdivision of land, although one new planting of walnuts and filberts has recently been reported in the Coombs area.

Although sweet chestnuts are not grown commercially in the province at present, growing conditions in the three study areas suggest that limited commercial trials of the hardy Gellatly and Childgen selections should be made.

RESEARCH AND EXTENSION PROGRAMS ON TREE NUTS

A very limited amount of research has been done on tree nuts in British Columbia. The Saanichton Research Station carried a small program on tree nuts during the 1920's, 30's and 40's, and published a number of papers and technical bulletins at that time as guidance to those interested in planting nut trees. Experiments were conducted with walnuts, chestnuts, filberts, almonds and pecans for about twenty years but the work eventually gave way to more pressing research needs. At the present time the Saanichton station has a small block of sweet chestnuts (15 trees planted in 1984) which may yield useful information in the years ahead. A single old walnut tree is still bearing good crops, but the crows are said to harvest all the nuts.

Records show that the Agassiz Research Station had a block of about 40 walnut trees planted in 1913 which reached tremendous stature. By 1943 it is reported that these trees had attained a height of fifty feet and a spread of forty feet. Unfortunately the whole block was killed by the Nov. 11, 1955 freeze and was not replanted. At the present time the Agassiz Station has a program on leaf analysis and nutrition of filbert trees. Observations made on major and minor element needs have been useful to growers in establishing better fertilizer programs.

The Provincial Ministry of Agriculture and Food has a filbert variety trial underway at the Abbotsford Test Station. This program is already yielding useful information on both old and new varieties of filberts.

It appears that for the short term, British Columbia filbert growers will have to rely heavily on the research findings at Oregon State University. O.S.U. has a strong research program on filberts, including variety breeding, cultural techniques, insect and disease control, and processing, drying, and storing of nuts.

British Columbia has a strong horticultural extension program in the south coastal, Okanagan and Kootenay regions. District Horticulturists are available at all major centres. In addition the province has a tree nut specialist located at Abbotsford which is close to the centre of the existing industry.

The present uncertainties concerning tree nut production in the Okanagan and Kootenay Valleys could be at least partially overcome by a well-managed demonstration project at the Okanagan Test Orchard near Oliver. It is suggested that the British Columbia Fruit Growers' Association may wish to examine tree nuts as an alternative to tree fruits by initiating a variety adaptation trial and cultural demonstration.

OVERVIEW OF OREGON AND WASHINGTON NUT INDUSTRIES

Oregon's mild climate, with only small changes of temperature, and limited danger of spring frosts and winter freezes, makes this area ideal for filbert production. To a somewhat lesser extent, the same is true of southwestern Washington.

The filbert industry in Oregon is growing steadily while the walnut industry has virtually disappeared. In Oregon there are now over 1000 filbert growers tending about 22,000 acres of orchard. Production is about 16,000 tons of unshelled filberts annually and is expected to climb to about 20,000 tons in 3 or 4 years.

Oregon marketers have their sights set on the European market to absorb this additional production. They have already made substantial sales to Germany. The German market is for large nuts of the kind produced in the Pacific Northwest. Only a few of such large sizes are produced in Turkey and Italy.

Table 2 indicates a violent drop in 1983 yield and price compared with previous years, but this is considered to be an unusual phenomenon and expectations are for increases in both yield and price in subsequent years. Washington production is more

TABLE 2

FILBERTS

February 1984

ITEM & AREA	UNIT	1979	1980	1981	1982r	1983p
			(IN-SHELL BASIS)			
OREGON						
Total Production.....	tons	12,700	15,000	14,400	18,400	7,500*
Utilization of sales:						
sold in shell.....	"	7,300	8,600	8,200	9,800	/1/
shelled.....	"	5,400	6,500	6,200	8,600	/1/
Shelled meats produced	thou lbs	4,290	5,200	5,000	7,000	/1/
WASHINGTON						
Total Production.....	tons	300	300	300	400	200
Utilization of sales:						
sold in shell.....	"	230	199	200	170	/1/
shelled.....	"	70	101	100	230	/1/
Shelled meats produced	thou lbs	60	84	80	140	/1/
UNITED STATES						
Total Production.....	tons	13,000	15,400	14,700	18,800	7,700
Utilization of Sales:						
sold in shell.....	"	7,530	8,799	8,400	9,970	/1/
shelled.....	"	5,470	6,601	6,300	8,830	/1/
Shelled meats produced	thou lbs	4,350	5,284	5,080	7,140	/1/
FARM PRICE						
Oregon.....	$/ton	951	1,151	786	680	579
Washington.....	"	970	1,181	770	677	728
United States.....	"	951	1,152	786	680	583

r - revised p - preliminary 1/1 July 5, 1984

SOURCE: Compiled by Extension Economic Information Office, Oregon State University, from USDA and other government reports.

* Later revised to 12,000 tons.

difficult to pinpoint as most Washington growers ship their nuts through Oregon processors and shippers. However, it appears that Washington production is of the order of 400 tons.

In spite of disastrously low filbert crops and prices in 1983 (as low as 29¢ U.S. per pound to the grower), there remains a fair amount of enthusiasm for filbert production in these States. Growers claim to need 45¢ U.S. per pound to meet their costs.

About 29% of the Oregon-Washington crop (about 5000 tons annually) is currently sold in-shell in the United States, the balance of the in-shell product (1800 tons) being exported, mainly to Germany. As mentioned previously, there is optimism about increasing demand in Europe for large-sized nuts from the Pacific Northwest.

Sales of shelled filberts from Oregon and Washington have been increasing, having exceeded 5,000,000 pounds annually in recent years. This represents about 60% of their current production. Nevertheless, the Northwest industry has been distressed with difficult competition from Turkey which has dominated the kernel market for many years.

Sales of in-shell nuts in the United States are regulated by a filbert marketing order. This means that any in-shell sales in excess of the domestic quota set by the State Filbert Control Board must be exported. Nuts which remain unsold in either of these markets must be shelled and sold as kernels at a lower return to the grower. The Oregon Filbert Commission is in charge of sales promotion and encourages production research. The U.S. industry is interested in blanching and roasting hazelnut kernels in an effort to capture more of the roasted nut market. Imported hazelnuts are blanched, ready for use by nut mixers. Blanching means removal of the brown skin from the nut kernel. Oregon varieties do not blanch well, but research is underway on this problem. Barcelona is the main Oregon variety but there is currently a lot of interest in the new varieties Ennis (main crop) and Butler pollenizer).

The filbert industry is well endowed with machinery and equipment suppliers, and is fully mechanized at the present time. Research and extension support is excellent. There are plenty of processors, packers, shippers, and nurseries available for existing and new growers. Many of the large growers have their own processing and drying facilities but rely on marketing organizations to make their sales. Smaller growers pay custom service charges for processing and drying.

The Nut Growers' Society of Oregon, Washington and British Columbia is active in promoting the nut industry. This organization is in its 69th year and serves filbert and walnut growers well in providing the latest information on industry developments. It also maintains a bargaining committee to meet with nut buyers on price negotiations and other aspects of marketing. Oregon grade standards are in place for both kernels and in-shell filberts.

Land suitable for planting filberts sells for $1500 to $2000 U.S. per acre in Oregon, while prices for bearing orchards are in the vicinity of $3000 to $4000 U.S. per acre. Filbert orchards are seldom irrigated except when young.

Custom harvesting of nuts is available at 6½¢ per pound while custom washing, drying and grading costs $52 U.S. per ton plus $1.30 U.S. per ton for each percent of moisture above 20%.

Commercial walnut production in Oregon and Washington has dwindled in recent years to a mere handful of orchards. Early in this century, many acres in Oregon and Washington were devoted to this crop. Successive fall and winter freezes and a number of disease, insect and physiological problems have hastened the

demise of walnuts, but probably the largest single factor has been the intense competition from California which has developed high-yielding lateral-bearing varieties which cannot be successfully grown in Oregon, Washington or British Columbia. California walnut trees yield twice as much crop as Oregon trees and nearly three times as much as British Columbia trees. The more hardy but less productive tip-bearing varieties have been grown in Oregon, Washington and B.C. Among these, the Broadview, Cascade and Chopaka varieties appear promising under B.C. conditions from the point of view of hardiness, productivity, nut size and kernel quality.

B.C. AREAS SUITABLE FOR PRODUCTION

There is no question that the favoured area in B.C. for filbert production is the South Coastal area. It is here that the moderating influence of the Pacific Ocean results in mild spring temperatures and moderately temperate summers and winters. Walnuts, filberts and chestnuts are all extremely vulnerable to heavy spring frosts and any area that frequently experiences temperatures below -10°C during the pollination period (January to May) is not likely to have a favourable experience in nut production. Similarly, any area which experiences temperatures below -35°C in winter cannot be considered suitable for tree nuts as the trees are likely to be killed or severely injured by such temperatures. Examination of weather records for the Okanagan, Kootenay and South Coastal areas suggests that Vancouver Island and the Gulf Islands have the most favourable record of January to May temperatures required for optimum pollination. The Fraser Valley also has a good February-May record although it is likely that severe January frosts have periodically reduced nut crops in that area. The frequency of severe frost at pollination time suggests risk of periodic crop loss from this cause in the Okanagan and Kootenay areas.

Table 3 outlines the frequency with which temperatures dropped below -10°C during the critical months of January, February and March for the period 1951 - 1980 in the three regions. Winter temperatures have not dropped below -35°C in any of the subject areas during the past thirty years, although temperatures below this level have been recorded in the Okanagan and Kootenay regions in 1949-50 and three or four times prior to that. From the tree survival point of view, it is likely that an early fall freeze (before trees have reached full dormancy) is even more destructive than extreme cold during full dormancy.

TABLE 3

Station	Years of data # between 1951-80	Number of times the minimum temperature was ≤ -10°C						
		JAN	FEB	MAR	APR	OCT	NOV	DEC
Hope A	30	128	12	11	0	0	7	46
Abbotford A	30	66	8	4	0	0	4	27
Van Int A	30	24	1	0	0	0	4	21
Cortes Is	27	1	0	0	0	0	0	3
Saltspring Is	26	5	2	0*	0	0	3	7
Saanichton CDA	30	2	1	0	0	0	4	6
Nanaimo A	30	43	3	2	0	0	6	13
Comox A	30	21	0	2	0	0	0	9
Alberni L.C.	24	29	3	3	0	0	4	10
Port Hardy	30	12	0	3	0	0	0*	2
Okanagan Centre	30	171	73	25	0	0*	23	82
Penticton A	30	209	65	20	0	0	31	91
Keremeos	28	223	65	22	0	0*	30	107
Osoyoos	26	191	51	6	0	0	20	84
Creston	15 (1951-66)	140	110	66	0*	0*	48	91

\# note that some stations do not have a full 30 years of record eg. Creston
* long-term values indicate that the minimum temperature has been ≤ -10°C during this month but not during the period of record used above.

Source: Climatology Unit
Air Studies Branch
B.C. Ministry of Environment

Well-drained moisture-retentive soil is the other critical requirement for nut crops. Nut trees have a fairly wide tolerance to soil types but in all cases the soil must be deep, fertile and well-drained. The term "well-drained" means well-drained all year round - no high water table at any time or puddling during rainy seasons. Filberts must have at least three feet, and preferably more, of productive moisture holding topsoil with no impervious hardpan below. Walnuts and chestnuts, being larger trees, require an even deeper soil. Heavy clays, mucks, and light sandy soils should be avoided. Suitable soils are present in all three subject regions.

South Coastal Area

The Chilliwack-Agassiz-Greendale area which is the present centre of commercial filbert production and boasts goodly numbers of walnut and sweet chestnut trees comprises flat to rolling land along the Coast Plain adjacent to the Fraser River. There is a large acreage of land in this area suitable for tree nut production, even though a good portion of it would benefit from installation of drainage systems. Table 4 outlines land classifications in the district. More than three percent of the land in the area, or 93,900 acres, is in the Agricultural Land Reserve, approximately half of this comprising CLI Classes I to III land. As in the rest of the Fraser Valley, agricultural development in this district is to some extent obstructed by the intermingled nature of urban and farm land.

Competition for land by commerce, industry and suburbia as well as agriculture increases expectations of the returns to land use, thus raising land prices to urban levels. In general, parcel sizes are small and prevailing land prices encourage separation of such parcels from larger holdings. Many small agricultural holdings in the district are underutilized, due partly to the lack of an infrastructure for small scale production.

TABLE 4

LAND BASE	CHILLIWACK AREA Hectares	%	MAINLAND A.R.R. Hectares	%
TOTAL LAND AREA	1 080 284	100	2 987 463	100
AGRICULTURAL LAND RESERVE	37 560	3	106 020	5
Class I	110	-	1 560	-
Class II	6 830	0.6	19 930	0.7
Class III	10 530	1	43 000	1
Class IV	8 230	0.8	53 570	2
AGRICULTURAL PRODUCTION				
Total Farmland	22 284	2	91 113	3
Owner-Operated Farmland	15 883	1.5	66 107	2
Leased Farmland	6 401	0.5	25 006	1
LAND USE				
Area Improved	19 185	2	75 379	2.5
Crops	12 922	1	48 136	1
Pasture	5 120	0.5	21 366	0.7
Fallow	100	-	750	-
Other	1 042	-	5 127	0.2
Area Unimproved	3 099	0.3	15 735	0.5
Woodland	1 312	0.1	5 302	0.2
Other	1 787	0.2	10 433	0.3

NOTE: Percentages may not add due to rounding.

Source: Statistics Canada 96-711 and 96-810.

B.C. Land Inventory Report, Volumes I and II, Talisman Projects Inc.

Data from the British Columbia Assessment Authority show land prices here to be well above the provincial average, though below prices in the Abbotsford district. The average 1983 land price recorded by the BCAA for the Chilliwack Assessment Area was $5959/acre compared with a provincial average of $1090/acre and an Abbotsford district average of $10,017.

Abundant rainfall and mild temperatures with a long frost-free season characterize this area. Average annual precipitation varies between 65 inches at Agassiz, 68.5 inches at Chilliwack and 56 inches at Cultus Lake. The highest mean daily temperatures occur during July and August, while mean daily maximum temperatures remain above 13^{o}C April through October. Frost free period is 208 days at Agassiz and 213 days at Chilliwack. Growing days are in excess of this. The frequency with which temperatures drop below -10^{o}C during February and March, the critical pollination time for nut crops, is outlined in Table 3. Further information on this area may be found in the Agriculture Profile for the Chilliwack District, dated December 1980 (ARDSA Project 271024).

Although there are many well-drained parcels of land in the greater Cloverdale area, a large percentage of the land in this area is unsuitable for nut crops owing to wetness and in some cases adverse soil properties (heavy clay, muck etc.). The same is true of the Delta-Richmond area. Climate is not a constraint to this area, there being abundant rainfall, mild temperatures summer and winter and a long frost-free period.

More than 50% of the land in the Abbotsford District falls into the Canada Land Inventory I to III classification. More than 100,000 acres are presently in farm use, with average farm size of 35 acres. Much of this is well-drained and would be suitable for tree nuts. The Sumas Prairie proper, however, is probably too

wet for tree nuts during the rainy season. Land values in the area are high and competition from other sources discourages use for anything but the highest value crops. Good agricultural land has been alienated for housing, service industries and recreation. There is also a demand for good raspberry land. Recent data from the B.C. Assessment Authority shows that farmland sold in 1983 at an average price of $10,017 per acre compared with a provincial average of $1090. Climate in the Abbotsford district is reasonably favourable for tree nuts.

There are many locations on Vancouver Island and the Gulf Islands that are suitable for tree nuts. The area has a history of producing this crop successfully, but urban encroachment on Saanich Peninsula and in Comox eliminated the acreage which was planted during the 1930's and 40's.

Of the three main climatic zones on Vancouver Island, only the relatively dry southeast coast is suitable for cropping. Temperatures are exceptionally moderate in the area, the seasons having no sharply defined limits. Precipitation is heavy in winter, minimal in summer, the southeast coast receiving less than 35 inches per year. Coldest temperatures ever recorded show Victoria at -14^{o}C, Nanaimo -19^{o}C and Comox -21^{o}C. Gale force winds are the most severe element of the climate. The frost-free period ranges from 231 days at Saanichton to 180 days at Comox and Nanaimo. Although land prices are high, there are many silt loam, fine sandy loam, and silty clay loams on Vancouver Island which are well-drained and would be suitable for tree nuts. Suitable locations exist on the Saanich Peninsula, Cobble Hill, in the Cowichan Valley, and the Nanaimo-Ladysmith area. Soils on the Gulf Islands tend to be more shallow and are generally summer dry. With irrigation at critical times they would no doubt be satisfactory for tree nuts.

A 1976 report by S.G. Preston shows that there are close to 10,000 acres of C.L.I. Class 3 or better land on the Gulf Islands.

Agricultural land is under constant pressure of requests for subdivision of farm units into smaller part-time farm units or urban lots. Data from the British Columbia Assessment Authority shows that market prices for farm land are high, average prices in 1983 being as follows:

Saanich and the Islands	$9,871 per acre
Cowichan Valley	4,164 " "
Nanaimo	8,067 " "
Courtenay	2,170 " "
Provincial Average	1,090 " "

Okanagan-Similkameen

The tree fruit industry of this area is situated at elevations between 903' (Osoyoos Lake level) and 1600' above sea level. Much of the acreage is on benchlands with a minor portion on the valley floor. Soils in the area are highly variable but generally well-drained. In general, it can be said that any soil on which tree fruits are successfully grown would also be suitable for tree nuts. Unlike coastal regions, irrigation would be necessary in most locations within this area. Soil type is not a limiting factor for tree nuts in the Okanagan-Similkameen, except that excessively stoney or coarse sandy soils should be avoided.

On the other hand, climatic characteristics raise questions about the merits of attempting commercial tree nut production. Although climate in the area is one

of the mildest in Canada, with warm summers and mild winters, there are usually one or two cold periods during nut pollination time in February and March which could periodically affect the set of nuts. In addition, meteorological data show that extreme low fall and winter temperatures which are beyond the ultimate cold tolerance of nut trees have occasionally been experienced. Some hardy varieties of walnuts are known to pollinize as late as May and it is with these varieties that the best production opportunities exist. A series of well designed trials with hardy varieties prior to the establishment of commercial plantings appears essential.

Among the factors affecting micro-climates in the valley depressions is altitude, which has an important influence on temperature. The temperature drops as elevation is increased. Cool air which drains from the valley benches, collects in the valley bottoms making the benches less susceptible than the valley bottoms to spring frost. Frost and freeze danger is also offset by valley lakes. It is significant to note that nut growing has not been commercially successful in eastern Oregon, due mainly to climatic constraints.

The Okanagan-Similkameen enjoys from 210 to 225 growing days during which light frosts may occur. Frost-free period is 150 days at Oliver, 184 days at Keremeos, 142 days at Penticton and 177 days at Summerland according to meteorological records. Data in Table 3 is significant for this area.

Land values in the areas are high for reasons similar to those in the South Coastal area. B.C. Assessment Authority records show Okanagan-Similkameen 1983 farmland market values as follows:

	Orchard Land
Penticton	$15,525
Kelowna	$16,993
Oliver (BCMAF 1984 reports)	$13,000 to $15,000

Kootenay Area

With two or three minor exceptions, the Creston Valley is climatically the most favoured area of the Kootenays, being 4° C warmer in January than the Cranbrook area. At 193 days, the growing season is relatively long. The frost-free season is 144 days. Because of the shorter growing season and more humid air than the Okanagan Valley and lower ultimate cold temperatures in some winters, the Creston Valley is somewhat more restricted in the kinds of trees grown. At present there are about 2000 acres of commercial tree fruit orchards on irrigated benchland in the vicinity of Creston, Wynndel and Boswell. The yellow-brown fine textured soils on these benches would be suitable for tree nuts. Microclimates in the Castlegar, Ooteshenia, Robson, Fruitvale, and Kootenay Bay areas suggest that hardy tree nuts can also be grown there. A high water table on the Creston Flats has heretofore restricted planting of orchards, but this water table is said to have been lowering in recent years, removing drainage as a constraint to tree growth. Air drainage with consequent reduced hazard of frost would still put the benchlands ahead of the flats as a location for early blooming crops however. Heavy snows (58 inches at Creston) in some winters may be a constraint to tree nuts owing to limb breakage.

Data presented in Table 3 indicate a marginal situation for tree nuts, especially during the February-March pollination period. The frequency of temperatures below -10°C at this time undoubtedly has affected the set of nuts.

Land availability is not a constraint to further tree plantings, there being plenty of Class III or better land available. Average farmland values in the Nelson Assessment area are reported to be $2864 per acre for 1983 with orchard land valued at $12,958 per acre.

PRODUCTION REQUIREMENTS FOR TREE NUTS

As already indicated, the two main production requirements for tree nuts are a deep, fertile, well-drained soil and a favourable year-round climate. Soils ranging from fine sandy loam through silty clay loams are satisfactory for all tree nuts. Gravelly and coarse sandy soils, heavy clays (gumbo) and mucks should generally be avoided. The soil should be at least three feet deep for filberts and even deeper for walnuts and chestnuts (5 to 6 ft.) if trees are to reach their normal stature. In all cases, the soil must be well-drained with no tendency to water table or extended puddling because nut trees cannot tolerate "wet feet".

Climate is no doubt a more limiting factor in British Columbia than soil. Catkins on nut trees are normally developing and shedding pollen in January, February and March (sometimes even earlier) and female flowers are opening about the same time. Some catkins are killed by temperatures below $-10^{o}C$ and female flowers killed by temperatures below $-12^{o}C$. The frequency with which temperatures drop below these levels in the various areas under study is a good indicator of risk involved in growing tree nuts. Table 3 outlines this frequency.

Provision of cross pollinators is also a critical requirement for filberts and useful for walnuts and sweet chestnuts as well, as yields are always greater where proper cross-pollination occurs.

Variety selection is most important as well. Up to now, Duchilly has been a reliably hardy filbert variety bearing good crops of nuts of acceptable quality. Daviana has often been used as a pollenizer. Ennis is recommended for limited

commercial trial as a main crop variety with Butler as a pollenizer. Oregon growers are also interested in these varieties as a replacement for their main variety, Barcelona.

With walnuts, it is essential to select a variety which commences growth and leafs out late in the spring. Franquette at the coast and Broadview, Cascade and Chopaka in all three study areas appear useful in this respect. The earlier leafing and more productive California varieties are out of the question here.

Sweet chestnut varieties should be of the Castanea molissima or C crenata varieties owing to their blight resistance. Gellatly and Childgen selections are favoured for their late pollination and local adaptation characteristics.

Irrigation may be necessary on young trees in dry years or in droughty locations. Established trees in the South Coastal area should not require irrigation, but trees in the Okanagan & Kootenay areas will likely require irrigation at intervals.

Good nutrition is an essential element of production. Recommendations for major and minor elements are presented in various extension publications and, for filberts, in a recent Agassiz bulletin.

Proper insect, disease and weed control are essential to the production of nuts. Aphids and leafrollers have been troublesome on filberts and these and other insects on walnuts. Again, control recommendations for these are outlined in extension publications. Good weed control helps conserve soil moisture and also maintains a smooth orchard floor for mechanical harvesting. A combination of repeated flailing and chemical control around the trees is considered best.

Gopher control may also be important at some locations.

Pruning to maintain vigorous new growth is important. Growing filberts as multi-stem trees is also useful as a precaution against winter injury to trunks which occasionally occurs in single stem trees.

Tree spacing is a most important consideration when setting out an orchard. Walnut and chestnut orchards appear to yield best in the early years when planted 20' x 20' with a diagonal removal of trees as soon as they begin to crowd. The same is true of filberts which, in a trial at Wilsonville, Oregon yielded best on a 10' x 20' planting. Results of this Oregon State University test are reported in Table 5.

TABLE 5

Filbert Production/Acre

Tree Age End of Year	Production / Tree	20x20 Trees/Acre (100t/a)	16x20 18x18 (130t/a)	14x20 16x18 (150t/a)	12x20 14x18 (175t/a)	10x20 12x18 (200t/a)
2	.2 lbs.	20	26	30	35	40
3	.5	50	65	75	87.5	100
4	1	100	130	150	175	200
5	2	200	260	300	350	400
6	3.5	350	455	525	612	700
7	6	600	780	900	1050	1200
8	9	900	1170	1350	1575	1800
9	12	1200	1560	1800	2100	2400
10	15	1500	1950	2250	2600	3000

Source: University of Oregon Extension Service Report. 1981

HARVEST AND STORAGE REQUIREMENTS

Nuts mature during September and October and are ready for gathering when they begin to fall. During October a thorough shaking of the trees by windforce from a helicopter will knock most of the nuts to the ground. It is important to get the nuts onto the orchard floor before the fall rains begin and not to leave them there too long. Nuts left on wet ground too long develop undesirable stains which adversely affect their marketability. The harvest operation is usually completed by mid-November.

In most mature orchards, nuts are now harvested mechanically with a sweeper which windrows the nuts and husks on a smooth orchard floor. In some years the nuts must be gathered several times as they fall. A mechanical pickup follows the sweeping operation and the nuts and other debris are placed in tote bins for hauling to a processing plant. Here the nuts go through a processing line where they are dehusked and deblanked with forced air, pressure washed with water, desticked and destoned, sanitized with a chlorine rinse, and placed in a drier where they are held in a circulating warm air blast (not higher than 37^{o}C) until the moisture content of the kernels is reduced to about 9% moisture. Rapid drying following harvest is essential in preserving high quality in the fresh sweet kernels. Following drying, they may be graded, sacked and stored or held in sealed tote bins until sold. When the kernels are fresh, they are plump and crisp, but as they dry they shrink and become quite rubbery. When properly dry and ready for storing, the kernels again become crisp. Drying must continue until the second crisp stage (about 9% moisture) or the nuts will mould. In some plants the dried nuts are treated with Sulfur dioxide to bleach the shells and make the nuts more attractive.

In the case of walnuts, chlorine bleaching is necessary to improve appearance of the shells.

Sweet chestnuts must be harvested more frequently than the other nuts owing to their tendency to spoil quickly. Harvest is by hand and is costly in that nuts must be gathered every second day during drop. Curing with circulating heat at 21°C for about five days usually gets the kernel moisture content down to 9%.

After drying, nuts are graded, sized, sometimes fumigated and packed in plastic lined boxes, bags or bins. The purpose of the plastic lining is to prevent the nuts from absorbing moisture and foreign odours from the air or from other products. Storage life depends largely on temperature. In a cool dry storage, filberts will keep in good condition for at least 8 months, after which cold storage is desirable. Regular inspections for insects, moulds and other deterioration are important. Redrying, refumigating and rebagging may sometimes be necessary. Although it is not a good idea to store nuts for more than one year, at 0 to 2°C with 60% relative humidity, filberts will keep for 2 years, while at -4 to -3°C, they will store for 4 years. Cold storage at 0 to 2°C is especially important for chestnuts as their tendency to spoilage is greater than the other nuts.

POTENTIAL CONSTRAINTS TO PRODUCTION

In British Columbia, there are a number of constraints to the production of tree nuts which have no doubt dampened growers enthusiasm for growing these crops. Among the most important of these are the following:

(1) Time to reach full bearing

The length of time taken by tree nuts to reach full bearing has no doubt discouraged some growers from pursuing this crop. This is particularly true of walnuts and chestnuts where a producer is faced with at least a 10 year wait for the first commercial crop and closer to 20 years to reach full bearing. Even after this long wait, the revenue rewards from walnuts and sweet chestnuts (unless sold at prices close to retail prices) are highly questionable. With filberts, the wait is shorter. Growers can expect to recover annual production costs by the fifth or sixth year and, even at wholesale prices for nuts, to receive a return for their management, labour and investment by the tenth year. Nevertheless, growers have tended to plant crops with promise of earlier returns, such as vegetables, or berry crops.

One technique which may help a grower offset the cost of waiting for tree nuts to bear is intercropping young orchards up to 4 years old with such crops as beans, sweet corn, strawberries, or cole crops.

(2) Spring Frost

All parts of southern British Columbia from time to time experience spring frost which can have an adverse effect on nut crops. Nut trees have the characteristic of starting physiological activity during the late part of winter. While there is an important difference among varieties in catkin appearance and leafing out, they all have the early growth habit in varying degrees. Winter and Spring

frosts damage walnut crops much more frequently than winter freezes injure the trees, and it is therefore important to grow only the hardiest late-leafing and late-pollinating varieties. Filbert trees normally bloom in January, February and March and require favourable temperatures at that time. Filbert catkins are known to freeze at $-10^{\circ}C$ and the female flowers at $-12^{\circ}C$, so that any area which frequently experiences temperatures at or below this level is not ideal filbert country. It should be noted however, that maturity of both catkins and female flowers on any given tree is phased over a period of several days which reduces the risk of total crop loss from a single frost. Table 3 describes the frequency of spring frost in the three study areas.

(3) Winter Freeze

Periodically, British Columbia experiences harsh winters with very low temperatures. When such winters occur, temperatures in the Kootenays and Okanagan are usually lower than those prevailing in the South Coastal area. During the period that nut crops have been grown in southern B.C., several devastating winters have occurred. The worst such winter in recent memory was the November 11, 1955 freeze when temperatures plummeted from $8^{\circ}C$ to temperatures of $-20^{\circ}C$ to $-26^{\circ}C$ overnight. Because nut trees, especially walnuts, are slow in attaining full winter dormancy, they were hard hit by that freeze. Large numbers of walnuts were killed outright. Filberts trees are ordinarily quite hardy, but even they suffered extensive damage as well. The Horticultural Newsletter of May 1956 records that "Filberts suffered extensive damage to young wood. As a result, there is very sporadic leaf development with little or no crop in prospect. There will also be some tree loss with late maturing varieties." Trees continued to show the effects of this freeze through 1957.

Records also show that nut trees were severely damaged in a 1949-50 freeze. Walnuts in the Agassiz-Chilliwack area and in the Okanagan-Kootenay areas were killed in large numbers. Interior tree fruits were hard hit by the same freeze.

Other brief references in the literature indicate that damage to nut trees from winter cold occurred in 1936 (October freeze), 1948 and 1968*

Owing to the danger of a repetition of these winter freeze conditions, only the hardiest available nut varieties should be planted.

Ice storms which often cause breakage in nut trees, especially in walnuts, occur in the Fraser Valley from time to time.

(4) High cost of machinery and equipment

In order to remain competitive, nut growers must be fully mechanized for harvesting and drying their crops. The alternative is to pay for custom harvesting and drying. Machinery and equipment costs are high, being in the order of $130,000 for a 60 acre filbert orchard. Almost all of the specialized equipment is available only in the United States, which, owing to the high rate of exchange, makes the equipment especially expensive for Canadian growers.

(5) High cost of land

The high cost of farm land in British Columbia is one of the most serious constraints to increased production of nuts. It is most difficult, if not impossible to get a satisfactory return to investment from such high-priced land. Pressure on land from urban and industrial users, and from investors who see land as a good long term investment, has forced land prices to very high levels in the three areas under study in this report.

*B.C. Department of Agriculture Annual Reports

(6) Pollination

Unsatisfactory pollination is one of the most frequent shortfalls in tree nut production. Walnuts, chestnuts and filberts are all wind pollinated. It is essential that filberts be cross-pollinated with a proper combination of varieties and in the proper frequency within an orchard. Walnuts and chestnuts are generally self-fertile, but crop yields are enhanced with good cross pollination. The reasons for unsatisfactory pollination are only partly explained. Spring frost no doubt is a major factor. Rain during pollen release is likely another as rain will scrub the pollen from the air. Closely associated with the problem of pollination is the alternate bearing habit of nut trees. Filberts in particular tend to bear a good crop one year and a light crop the next. This is likely a result of poor flower and catkin initiation during the heavy crop years. Research has not yet recommended a solution to this problem.

(7) Orchard Location

Emphasis has been given in this report to the need for a deep well-drained soil with good fertility level and moisture-holding capacity. Frost-free locations should be sought.

(8) Insects, Diseases and Pests

British Columbia growers are somewhat better off in the matter of insects and diseases than their Oregon counterparts. In general, filberts require controls only for aphids and leafrollers, and possibly the occasional spray for Lecanium Scale. B.C. does not yet have the Filbertworm, Bacterial Blight or Eastern Filbert Blight which are so troublesome in Oregon. In 1974, Canada imposed phytosanitary regulations aimed at preventing the entry of these problems. *

*Quarantine Circulars - Canada Department of Agriculture 1974

Walnuts require controls for aphids, leafrollers and walnut blight. In interior valleys, codling moth and mites may also require control.

There are a number of pests which can be a problem to nut growers. Depending on the incidence of gophers and moles, deer, blue jays, squirrels, or crows in the vicinity of a nut orchard, these critters may or may not be a problem.

Under the non-tillage system of orchard management, gophers and moles can be a problem. Controls must be applied to prevent tree kill from root damage. Deer and elk are known to be a problem on all kinds of young nut trees and must be fenced out in areas where they occur. Blue jays, squirrels and crows will steal nuts at a surprisingly brisk rate. Prompt harvest and possibly scaring devices are necessary where large numbers of these pests are present.

(9) Infant Industry Syndrome

One of the constraints to an increase in the nut industry is the fact that the industry is rather small at present and does not enjoy the benefits of an industry infrastructure which the larger agricultural industries have. A grower going into the business is very much on his own in obtaining machinery, equipment, and supplies, trees, processing, drying, and marketing, and must often travel long distances to tend to these important aspects. He will find that, because nuts are a "minor crop" in Canada, few of the chemicals needed for production are registered for use on nuts in Canada. He will also find, for the same reason, that very little local research information is available.

T hese and other deficiencies can, of course, be corrected, and in the event that a substantial amount of new acreage is planted, various agencies would no doubt act to correct them.

PROCESSING AND DRYING FACILITIES

Any significant increase in the existing filbert acreage or entry into the walnut or chestnut business requires that attention be given to the availability of processing and drying facilities.

At the present time, there are four medium-sized orchard processers and driers located on nut farms in the Fraser Valley. These have the capacity to handle the existing 300 ton filbert crop quite comfortably and could handle probably double the present volume. Beyond this, there would be a need for increased cleaning and drying facilities which could be provided in a number of ways. Expansion of existing facilities to provide custom cleaning, drying and marketing services would be one way. This has the advantage of the facilities remaining in the hands of those growers who have experience in handling nuts under local conditions.

On the other hand, additional facilities could be built on new nut farms. These would ordinarily be orchard size facilities designed to handle the nuts from the individual orchards, possibly with sufficient extra capacity to handle some custom processing.

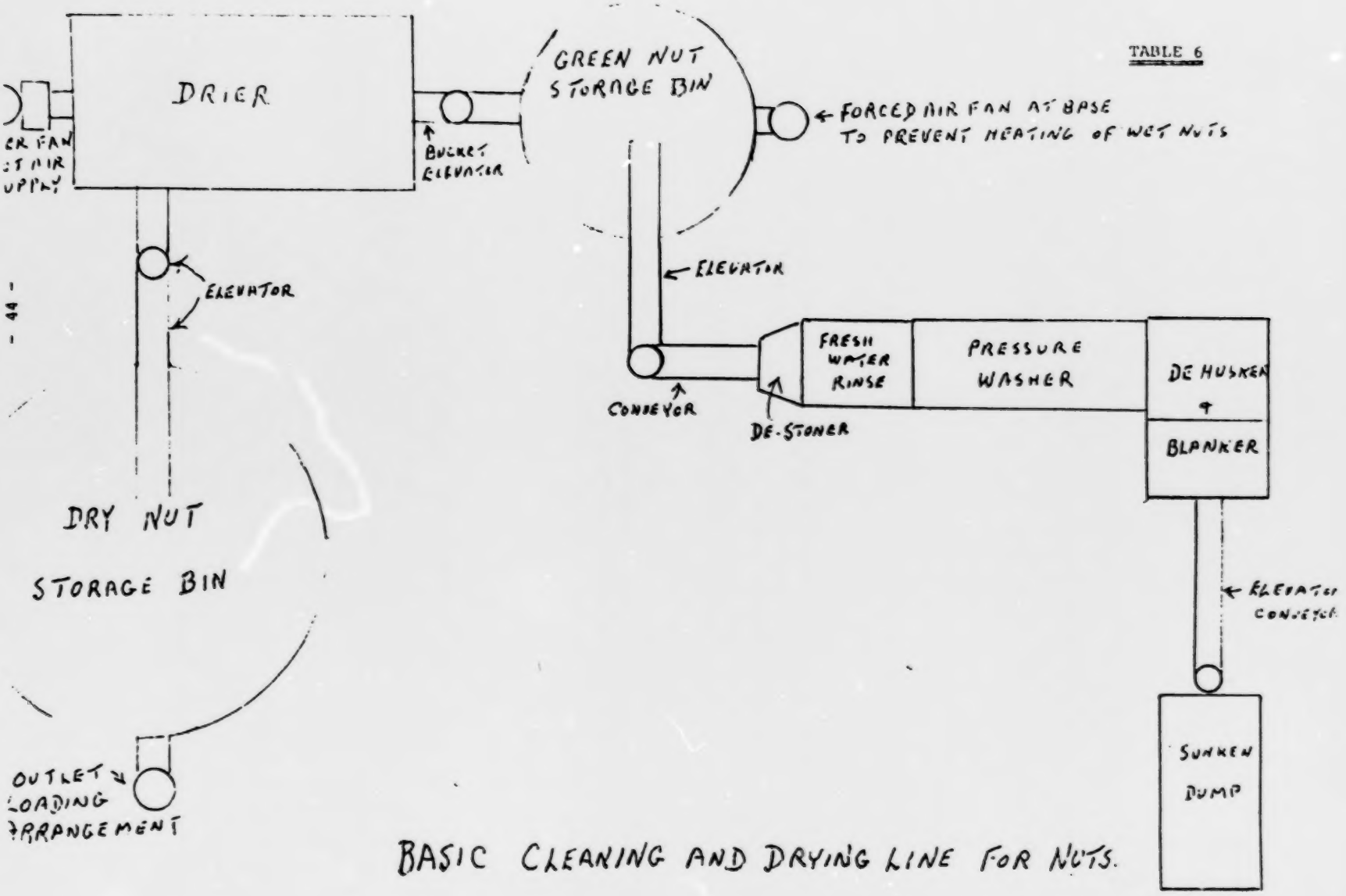
The third alternative is the building of a larger co-operative or private enterprise processing facility designed to handle several thousand tons annually on a custom service basis. It seems premature to consider this type of facility in B.C. at the present time.

ORCHARD PROCESSING FACILITIES

When tree nuts arrive at the processing plant following mechanical harvesting, they are often very dirty and mixed with sticks, stones, leaves, hulls, husks, clods and blank nuts. All must be removed in one way or another. Cleaning methods include blowing or vacuuming, revolving rollers, revolving drum or "squirrel cage" with water under pressure, and revolving tines and brushes. A de-sticker and de-rocker is almost always included in the cleaning line. A typical cleaning line for filberts is detailed in Table 6. In this line, the uncleaned nuts are brought from the orchard in either tote bins or a belly-dump trailer and dropped into a sunken open-top tank. A coarse mesh top on this tank is often used to remove sticks as the nuts are dumped. The nuts are elevated to a de-husker and blanker which removes most of the husks, leaves and blank nuts with forced air or vacuum suction. The nuts then go through a rotary drum washer where they are agitated, pressure washed and scrubbed to remove all dirt. This is followed by a fresh water rinse and sometimes a sanitizing spray of chlorine. Most lines have a de-stoner to drop stones away from the nuts which are then elevated either directly to the drier or to a holding tank while awaiting drying. After drying they may be sacked and sold or stored or held in a dry nut storage bin or totes.

Damp or undried nuts should not be stored for any length of time, because kernels mould quickly and off-flavours develop from heating of the mass. To avoid spoilage, nuts should be dried to an average kernel moisture content of 9%. Optimum drying temperatures are 32° to 35°C. Forced air circulation is equally as important as the warm air itself.

TABLE 6



BASIC CLEANING AND DRYING LINE FOR NUTS.

There are many different types of driers in use. All use the principle of forcing warm air upward through the nuts from an equalizing chamber under the drying bins. Natural gas or propane are most often used as a heat source. It is important that equal amounts of warm air penetrate all parts of the nut mass. The drier floor is made of wire mesh or expanded metal with suitable supports. Outlets for the moisture-saturated air are provided at the top of the drier.

The traditional type of nut drier is the stack drier. This consists of from 3 to 5 layers of bins, each with a collapsible mesh floor. The nuts are dropped into the top bin and lowered progressively to the bins below. As soon as all bins are filled, the warm air is forced up through them. As the nuts in the bottom bin dry to 9% they are released and the top lots lowered to the next bin below, the top bin then being filled with green nuts. This stage process continues night and day until all nuts are dried. It is difficult to get cost estimates on this type because growers using them often use an existing barn or other building in which to erect their plywood bins. Next to the tote bin type of drier, they are probably the lowest cost type of installation. Carpenters with expertise in such installations are available.

A second common type of orchard drier is the tote bin with a wire mesh floor. After the bins are filled with green nuts they are stacked over a heat chamber and air is forced through the bins. This is the lowest cost drier of them all and can easily be home built.

Some new types of orchard driers are appearing in Oregon. Most are grain driers purchased from the Canadian prairies. One Canadian company is in fact manufacturing a drier especially for nuts. One Oregon grower had installed a

large round steel drum type drier with rotating grain augers moving through a 75 ton mass of nuts. Such a large mass of nuts has not heretofore been dried in a single bin. His experience with the new system was said to be favourable, with no damage to the nuts. In fact, the constant agitation was seen to polish the nuts, giving them extra eye appeal. It certainly reduced the handling problem. Drying took 3 days. This drier was handling over one ton per hour and was operating 24 hours a day for the 4 week harvest season. This unit cost $14,300 (Canadian) installed and would handle 150 tons per week over the normal 4 week harvest period.

Another new type is using the continuous trickle principle of drying where the nuts enter the top of a stack drier and are allowed to trickle down through the stack, the speed of trickle being governed by a control gear at the base of the drier. The gear speeds up or slows down according to the moisture content of the nuts. This drier was handling 30 tons per day, or something over 900 tons in the 4 week harvest season. Cost was $45,500 Canadian installed, which appeared high when compared with other driers in the area.

Still another new type uses the heat pump principle and the grower involved said he was pleased with the results. Growers are extremely innovative when it comes to adapting equipment to their specific needs.

One leading manufacturer of nut cleaning and handling equipment quotes the following prices for complete cleaning lines (in Canadian dollars):

Small cleaning line (capacity 2 tons per hour)	$13,000
Medium cleaning line (capacity 3 tons per hour)	19,500
Large cleaning line (capacity 5 tons per hour)	32,500

In addition, a tote dumper is quoted at $1755 and a feed elevator with variable speed control (16" x 16') at $4030. Various other accessories such as bucket elevators at $48.75 to $55.25 per foot, work platforms at $565, and take-away bin conveyors at $42.25 per foot are available.

In summary, it appears that a custom made small type cleaning and drying line with a capacity of 2 tons per hour suitable for an orchard installation will cost the following as a minimum:

Cleaning line	$13,000
Drier (Butler Bin Type)	14,300
Accessories	8,000
TOTAL	$35,000

This does not include the building, pad or concrete tunnels which could increase the cost another $5000 to $8000 depending on whether an existing or new building is used.

The cost of operating a cleaning and drying line varies greatly depending on a number of factors. In the first place the amount of debris such as prunings, rocks, mud balls, weeds, leaves and other debris varies a good deal from orchard to orchard depending on the level of care, condition of the orchard floor, state of the trees and type of soil. As the amount of debris increases, the speed of the cleaning line decreases and the cost of cleaning increases. Similarly the degree of wetness of the mass will determine the amount of heat and driven air required to reduce kernel moisture to 9%. In 1984, many lots are carrying moisture levels close to 30% by weight, necessitating longer exposure to the heat source. A further unpredictable factor with the Duchilly variety is the degree of separation of husks from nuts. If there is good separation, costs are naturally lower than if separation is poor.

In the 60 acre model used in this study, the assumption is made that the Duchilly nuts to be cleaned and dried contain 5% debris and 25% moisture and that husk abscission is about normal for the variety. The cleaning line has a capacity of 2 tons per hour under ideal conditions but operates below capacity owing to the extra work required in removing husks. In this model 12.8 man hours of hired labour, supplemented by several hours of operator labour are required to clean, dry and grade a ton of nuts (dry weight basis). Natural gas for drying and electricity for driving the fans cost $48 and $3 respectively and sacks cost $26 per ton of dried nuts.

It must also be mentioned that under ideal dry fall harvest conditions it is often possible to air dry nuts without extra heat down to about 12 or 13% simply by forcing outside air through the mass a short heat exposure following this will quickly bring the kernel moisture to 9%.

A community-type cleaning line and drier with a capacity of 30 tons per day or 900 tons over a 4 week period was recently built from scratch at Junction City, Oregon. The cleaning line for this installation cost $54,600 and the drier $45,500. Building and installation including a scale for weighing incoming nuts cost another $65,000. It would therefore appear that the total cost of a community-type drier of this very modern type processing and drying facility is in the order of $165,000.

Custom service for cleaning and drying nuts by a plant of this kind costs a grower $60 U.S. per ton plus $1.30 U.S. per ton for each per cent moisture above 20%. This is substantially lower than the going rate in B.C. (20¢ per pound which includes marketing). Thus an Oregon grower with a 60 acre orchard of mature trees

and a yield of 60 tons of nuts annually would pay a basic $3600 U.S. per year to have his crop processed. The current trend in the United States is that more and more growers are using custom service for cleaning and drying their crop.

A community plant of this type could accommodate the crop from 900 acres of mature orchard over a four week period.

The Oregon Hazelnut Division of California Almond Growers has a plant in Salem which is cleaning and drying 6000 tons of hazelnuts annually. Their cleaning line is very large and they operate several stack dryers with tremendous capacity. This operation is probably too large for even the most optimistic forecast of increased nut acreage in B.C. and for this reason, the costs involved in establishing such a plant are not included here.

QUALITY OF PRODUCT

Officials in the nut buying trade are generally satisfied with the quality of British Columbia grown filberts, which are the only nuts available commercially in this province. They are all quick to mention the fact that the Duchilly variety is different from the American product in shape and shell finish but they have not detected any consumer resistance to it. Nuts are judged by their appearance, cracking quality, size, and shell-to-kernel ratio. The kernels themselves are judged by their skin colour and flavour of the meat.

Generally speaking, the trade buys as many filberts from B.C. growers as they can get. The fact that the Duchilly shell has a crease down one side, and its shell does not have as nice a finish as the Barcelona shell, does not deter them from buying the B.C. product.

One buyer mentioned the bloom characteristic of the Duchilly shell, saying he would rather see the bloom removed. Another said that he had received one or two lots of dirty nuts and still another mentioned one lot he had bought some years ago which had mud balls mixed in with the nuts. There were as well one or two references to "blanks" in some lots but this had not been a recent problem. Lack of standardized grading has obviously caused the trade some problems, and comments were made on the lack of bleaching, staining and waxing on some lots. These comments are not seen as significant criticism of the B.C. product. The general tone of buyers was instead quite enthusiastic. They would encourage the production of more acreage of filberts in this province. It is significant to note that B.C. filbert growers often sell their crop at harvest time and then hold the crop in storage for later delivery to buyers.

It is not surprising that there is lack of uniformity in the grading of local hazelnuts. There are no grade standards in Canada for this product at the present time and it therefore rests with growers and the trade to determine what is an acceptable product.

Oregon has established grade standards for both round type and long type hazelnuts in shell. These spell out the requirements for size, type, condition, damage, defects, and kernel quality. There is a separate set of standards for hazelnut kernels with fancy, number one, and number one whole and broken classifications. The value of a crop can often be improved by careful sizing and grading. Should the B.C. industry grow in size, grade standards would be an important part of intensified marketing activity.

Well dried nuts are not perishable and have high food value for their bulk. Good quality nuts are highly nutritional. The constituents of the three types of

nuts under study here are as follows:

Nutritional Constituents per 100 gms. of Kernels

	Calories	Protein	Fat	Carbohydrate	Ca	P205	Fe	Na
Walnuts	651	14.8g	14.6g	1.4 g	99mg	380mg	3.1mg	.8mg
Filberts	634	12.6g	62.4g	16.7g	209mg	337mg	3.4mg	-
Chestnuts	194	2.9g	1.5g	42.1g	27mg	88mg	1.7mg	6mg.

	K	Thia.	Ribo.	Nia.	Vit. A	Vit. C
Walnuts	195mg	.1 mg.	.04mg.	.3 mg.	30 I.U.	2 mg.
Filberts	704mg	.46mg	-	.9 mg.	-	-
Chestnuts	454mg	.22mg	.22mg	.6mg	-	-

Source: Produce Buying Guide
A reference manual for produce buyers by Blue Goose.

The yield of shelled nut kernels per pound of in-shell nuts is as follows:

English walnut	7 oz.
Filbert	7. oz.

Table 7 shows that there is a huge market in Canada for shelled filberts. Unfortunately, a large portion of this market is for blanched shelled nuts. At the present time, the Turkish variety Tombul dominates this market because of its blanching capability. B.C. and Oregon grown varieties do not blanch readily and cannot meet the requirements of those markets which require that the brown pellicles be completely removed. In time however, processing technology on Barcelona and Duchilly varieties or a breakthrough with new varieties will undoubtedly allow Pacific Northwest growers to compete effectively for this market.

MARKETING

At the present time, the marketing of B.C. grown filberts is handled by a few of the larger growers who provide a custom service to other growers in cleaning, drying, and marketing the nuts. There is no marketing organization as such, but the major buyers such as Canada Safeway, Empress Foods, Kelly Douglas, Overwaitea, Pine Tree Nuts, Federated Co-op, IGA and Westcoast Produce soon learn who has nuts to sell and often take the initiative in contacting major growers. Prices and delivery arrangements are established between individual growers and buyers.

There is no regular export trade in B.C. grown filberts, although records show that Canada exported 64 tons of in-shell nuts to the United States in 1972-73 and a further 22 tons in 1974-75.

Smaller growers of both filberts and walnuts often market their nuts on a U Pick basis and there seems to be a plentiful supply of ready customers. There is no established commercial market in B.C. grown walnuts as there are insufficient quantities available to interest the buyers. Present walnut growers are able to sell all their crop at prices well above wholesale price.

Table 7 shows that during the past 5 years total Canadian imports of in-shell filberts have consistently exceeded 600 tons annually, while imports of shelled and roasted filberts have exceeded 800 tons. Most of the unshelled nuts came to Canada from Oregon, with very small quantities coming from Italy, Turkey and the People's Republic of China.

Shelled and roasted filberts, on the other hand, came largely from Turkey, with Oregon also being an important source of supply. Nut meats go to bakeries, candy makers, confectioneries and other outlets in bulk and vacuum-packed cans. They are also packed in cellophane bags and cans for home use. Roasted and salted nuts are sold to beer parlours and party caterers.

During the past five years, total Canadian imports of in-shell walnuts have generally exceeded 2400 tons annually, often approaching 3600 tons. In-shell walnuts have come mainly from the United States (California) almost to the exclusion of other countries. Imports of shelled and roasted walnuts have been even heavier, having ranged between 3600 tons and 6000 tons annually. These have come mainly from the People's Republic of China, with the United States far behind as a supplier. Table 8 shows that large quantities of filberts and walnuts enter Canada through B.C. Custom ports. It is probable that the unshelled filberts so entering are destined for markets in the four western provinces. The same is true of the shelled filberts, all of which come from Oregon and Washington.

A discrepancy in shelled walnut figures for 1979, 1982 and 1983 prevented an accurate evaluation of imports through B.C. Custom ports, but it appears that between 3600 and 6000 tons of shelled walnuts have entered through these ports annually in recent years.

No trade figures are available on sweet chestnuts but the fact that the United States imports five to six thousand tons from Europe annually suggests that Canada likely imports a quantity proportionate to our population from the same source.

With this scenario on filbert and walnut imports, it is apparent that plenty of room exists here for import replacement. This is borne out by discussion with B.C. producers who report no difficulty in finding ready buyers for well-graded unshelled filberts. A few local entrepreneurs have shelled and salted their filberts and found ready markets, but the limited supply of locally produced nuts has prevented establishment of a steady product line. With current favourable exchange rates, there may be opportunities for sales into United States markets which should not be overlooked.

TABLE 7

TOTAL FILBERTS AND WALNUTS IMPORTED BY CANADA 1979-83

	FILBERTS NOT SHELLED		FILBERTS SHELLED		WALNUTS NOT SHELLED		WALNUTS SHELLED	
	Quantity Kg.	Value $	Quantity Kg.	Value $	Quantity Kg.	Value $	Quantity Kg.	Value $
1979	767,215	1,110,000	963,065	2,686,000	1,975,257	3,118,000	5,236,611	20,303,000
1980	606,360	1,474,000	843,391	4,067,000	2,230,700	3,901,000	3,109,352	9,490,000
1981	893,579	1,740,000	750,957	3,345,000	2,851,334	4,981,000	3,676,471	10,573,000
1982	818,314	1,431,000	795,398	2,114,000	2,231,368	4,416,000	4,792,217	14,067,000
1983	589,586	1,036,000	952,247	2,585,000	2,939,233	4,476,000	4,981,752	16,812,000

Source: Imports by Commodities and Countries
Statistics Canada Reports 1979 - 1983

TABLE 8

FILBERTS AND WALNUTS IMPORTED BY CANADA THROUGH B.C. CUSTOM PORTS 1979-83

	FILBERTS NOT SHELLED			FILBERTS SHELLED			WALNUTS NOT SHELLED			WALNUTS SHELLED		
	Quantity Kg.	Value $	% of Total Imports	Quantity Kg.	Value $	% of Total Imports	Quantity Kg.	Value $	% of Total Imports	Quantity Kg.	Value $	% of Total Imports
1979	113,947	85,290	14.9	141,395	121,793	14.7	753,823	472,794	38.2	8,295,611	14,736,313	72.6
1980	31,424	40,508	5.2	27,613	59,629	3.3	649,638	617,480	29.1	3,459,082	4,803,180	88.7
1981	291,352	260,184	32.6	38,476	82,017	5.1	638,158	484,098	22.4	4,248,789	5,480,456	85.3
1982	413,777	332,186	50.6	114,590	227,176	28.6	559,858	494,855	25.1	5,448,247	7,171,678	51.0
1983	228,344	180,231	38.7	177,666	281,681	29.6	578,421	366,210	19.7	5,941,739	8,845,065	52.6

Source: Imports through British Columbia Custom Ports
Department of Economic Development Reports 1979 - 1983

The few walnuts grown in this province also find a ready market at very satisfactory prices, but the quantities presently grown represent too small a test to be an accurate measure of market acceptance or economic feasibility. Prices received by B.C. growers have been well above California walnut prices, due mainly to the small volume of local nuts. Farm gate price for walnuts in B.C. is about $1.50 per pound, while wholesalers are offering about 85¢ per pound. As long as B.C. production remains at a level which can be absorbed by farm gate sales, prices will remain above wholesale levels.

Figures in Tables 7 and 8 suggest that an additional 700 to 800 acres of filberts at least would be required to replace the current level of imported unshelled hazelnuts entering Canada. Annual imports of unshelled filberts entering Canada in recent years have ranged between 700 and 1100 tons. Imports of shelled filberts have consistently exceeded 800 tons. While it is unlikely that additional supplies of B.C. grown filberts would entirely displace imports under the present free trade policy, there is little question that more aggressive and co-ordinated marketing strategies would displace substantial quantities of imports. In addition, normal population growth to the year 2000 and a continued upward trend in per capita consumption of nuts (Table 9), together with a modest B.C. entry to the shelled and roasted filbert market further support the expansion of B.C. acreage. New acreage planted over the next two or three years would be in full production by the year 2000. Market development work would be required in advance of that time.

While filberts are currently sold in-shell, shelled and chipped, other product development work is underway. It is likely that products such as filbert butter, filbert oil, filbert meal, and shell fuel will be marketed in the years ahead. At the present time, it is with the unshelled product that the best opportunity for import replacement exists.

The shelled filbert or kernel market is more difficult as low-priced Turkish hazelnut kernels are available in large quantities. They enter Canada tarriff-free. In addition, Turkey grows a variety of filbert named Tombul which blanches easily and therefore finds a ready market with nut mixers, bakeries and candy manufacturers. Canadian varieties do not blanch easily and are therefore not in strong demand as a shelled product. The U.S. industry also has a problem in this regard as their main variety, Barcelona, also does not blanch easily. That is one of the reasons that they are trying to find new varieties suitable for growing in the Pacific Northwest. They are, however, working on blanching techniques to remove the pellicles from Barcelona and if they should be successful, it is possible that the same process would be effective for Canadian varieties.

Roasting of filberts is likely to increase the demand for the shelled product. Roasted, the hazelnut is indeed a fine tasting product. However, roasted hazelnuts must first be blanched because the roasting process on present northwest varieties tends to remove only portions of the pellicle, leaving the nuts with a mottled unattractive appearance as well as a flaking of the pellicle when they are handled following roasting.

It is significant to note that per capita consumption of tree nuts in Canada is steadily increasing, having exceeded three pounds per capita in 1982. Table 9 shows the supply and disposition of all tree nuts in Canada.

TABLE 9

TREE NUTS[a]: SUPPLY AND DISPOSITION, 1960–1982

NOIX[a]: RESSOURCES ET UTILISATION, 1960–1982

Year / Année	Supply — Ressources			Disappearance — Utilisation		
	Production	Imports / Importations	Total	Exports / Exportations	Disappearance / Disparition	
					Total	Per capita / Par personne
	-		kilotonnes		-	- kg -
1960	-	10.15	10.15	0.15	10.00	0.56
1961	-	9.66	9.66	0.13	9.52	0.52
1962	-	9.35	9.35	0.12	9.23	0.49
1963	-	9.66	9.66	0.14	9.52	0.50
1964	-	9.98	9.98	0.14	9.84	0.51
1965	-	10.89	10.89	0.21	10.69	0.54
1966	-	10.90	10.90	0.31	10.59	0.53
1967	-	11.27	11.27	0.27	11.01	0.54
1968	-	11.89	11.89	0.43	11.46	0.55
1969	-	13.15	13.15	0.33	12.82	0.61
1970	-	13.17	13.17	0.32	12.85	0.60
1971	-	15.50	15.50	0.76	14.74	0.68
1972	-	19.88	19.88	0.82	19.06	0.88
1973	-	20.93	21.09	0.68	20.41	0.93
1974	-	20.19	20.32	0.24	20.08	0.90
1975	-	18.71	18.86	0.43	18.43	0.81
1976	-	23.29	23.51	0.48	23.02	1.00
1977	0.24	22.01	22.25	0.56	21.69	0.93
1978	0.24	21.86	22.10	0.78	21.33	0.91
1979	0.27	26.42	26.70	0.58	26.12	1.10
1980	0.25	28.96	29.21	0.31	28.90	1.21
1981	0.14	32.73	32.87	0.50	32.37	1.33
1982[p]	0.23	34.72	34.95	0.44	34.51	1.40

- Retail weight
  Poids au détail
[p] Preliminary
  Provisoire

Source: Commodity Supply and Disposition
Canada Industry Trade and Commerce Report 1983

POTENTIAL CONSTRAINTS TO MARKETING

Discussions with growers and buyers suggest that there are few constraints to marketing that cannot be overcome by dedication to do a first class job. Improved quality control is probably the greatest need at present. The trade wants to buy clean, bright-looking nuts which are uniform in size, shape and colour and are free from mould, blanks, broken shells and other defects. These qualities can be realized with close attention to cleaning, drying, and grading. It is essential that the B.C. industry keep its reputation clean by establishing some means of preventing poor lots from reaching the market. Industry grade standards would be a protection to those growers who are presently doing a conscientious job of quality control. Small nuts should be shelled for the kernel market, leaving the larger nuts for the higher priced in-shell market. Bleaching, staining and waxing of filberts to improve eye appeal would also enhance marketability.

The position of the B.C. nut industry would be enhanced by an increase in total tonnage available. Some members of the trade presently consider Oregon their natural source of supply for filberts, with only scant consideration of possible supplies from B.C. An increase in acreage sufficient to make local production a real "factor in the marketplace" is indicated.

The fact that low-priced Turkish nuts and nuts from other major exporting countries enter Canada tariff-free makes the Canadian industry a price follower rather than a price setter, although it must be acknowledged that Canadian buyers paid good prices for B.C. filberts in 1983 when U.S. price quotes were at disaster levels.

COST OF PRODUCTION

A cost of production analysis for a 60 acre filbert orchard in the Fraser Valley is presented in Appendix A. It is seen from the analysis of this model that investment in machinery, buildings and equipment totals $130,433 and that depreciation on these items, after trade in values are taken into account, costs the operation $110 per acre per year. It should be noted that not all equipment is purchased at the outset, harvesting, cleaning and drying facilities not being needed until the sixth year.

The cost of establishing the orchard in year 1 is seen to be high at $1339 per acre or $80,367 for the 60 acre block. The cost of buying and planting the trees constitutes almost two thirds of the total cost.

Cultural costs in years 2 to 5 are seen to be quite low, with no requirement for hired labour during this period.

Year 6 completes the addition of machinery for harvesting, cleaning, drying and pruning. Cultural costs increase in the sixth year owing to the start of mechanical harvest operations and the need for hired labour in the processing, drying and grading of the crop.

As expected, cultural costs increase between years 6 and 12 in direct proportion to the increases in crop yield. At age 12, the orchard is in full bearing and crops are assumed to remain at the 2000 pound per acre level each year thereafter. This orchard is seen to realize a gross return of $96,000 and $59,113 return over and above cash costs in the 12th year.

When debt servicing charges at 12% interest are taken into account and integrated from year to year, it is noted that the orchard is in a deficit position until the tenth year. Using the discount rate of 10% and calculating interest on investment at 12%, this full bearing orchard provides a return of $7618 to operator labour, management and investment in land, buildings and equipment. The model returns would of course be favourably affected by any drop in discount or interest rate and by an increase in market returns.

The cost of production analysis for walnuts follows a pattern similar to the filberts. The 30 acre orchard has a lower capital investment owing to the fact that harvesting, hauling, processing, drying and marketing are all carried out on a custom service basis.

Again the cultural costs of establishing the orchard in year 1 are quite high, owing to the high cost of trees and planting.

Cultural costs in years 2 to 11 are quite low, with no requirement for hired labour and harvest of nuts being on a U-pick basis.

Custom harvesting, processing and drying costs commencing in year 12 and continuing into the full bearing period at age 20 add progressively to the cultural costs as the crop increases from 550 pounds to 1500 pounds during this period.

When debt servicing charges at 12% interest and discount rate at 10% are taken into account and integrated from year to year, it is noted that the orchard is never in a profit position. Returns in this model however are based on wholesale prices for walnuts and since most B.C. walnut growers are receiving prices well above wholesale offerings, the model is not representative of the present small-scale production. Changing the market return to $1.50 per pound changes the outcome.

SUMMARY AND CONCLUSIONS

Tree nuts have been grown in British Columbia for many years, but have not been fully assessed for the potential they may hold for increased commercial production. At the present time, there are more than 600 acres of filberts in commercial production in the Fraser Valley area. The production from these trees, however, fills only a small fraction of the available Canadian market for hazelnuts. There are no commercial walnut or sweet chestnut plantings in the province.

Historical records reveal that several early attempts at tree nut production have been made in various parts of the province. However, filberts alone have stood the test of time, with modest growth in acreage of that crop having occurred during the past fifty years.

Climatic setbacks to tree nuts have occurred from time to time in all parts of the province. Severe winter freezes and ice storms have occasionally killed or severely injured nut trees and have discouraged new developments in these crops to some extent. Damage to walnuts has been the most severe, hardy filbert varieties having largely withstood the freezing temperatures and ice storms. Sweet chestnuts have not been affected by the winter freezes to any great extent. Winter and Spring frosts have taken a toll in nut crops as well, owing mainly to the early-flowering characteristic of tree nuts which makes their catkins and female flowers susceptible to January, February and March frosts. The incidence of frost and winter freeze in Interior districts together with the economics of production with presently known varieties and technology make tree nuts a good subject for research & production demonstrations in those areas. Climate in the South Coastal area is more favourable for tree nuts and there is

opportunity for expansion, especially for filberts, in the Fraser Valley and on Vancouver Island and the Gulf Islands. Limited commercial trials of hardy Walnut varieties should be encouraged.

Only a very limited amount of research has been done on tree nuts in British Columbia. The province relies heavily on the Oregon State University research program which answers B.C. needs in some respects but not in others. Work is needed here in further sorting out and perhaps breeding hardy varieties of walnuts and filberts which have better productivity and market acceptability than do existing varieties. The work of Gellatly and Childgen should be expanded and extended to commercial trials. Tree nuts would make a very good study subject for the BCFGA's Okanagan Test Orchard.

The province maintains quite a strong extension program considering the limited acreage of nuts.

It is interesting to note that the Oregon filbert industry has been growing steadily in recent years, while the walnut industry has virtually disappeared. There are now over 1000 filbert growers tending about 22,000 acres of orchard with a production of about 16,000 tons of nuts. The demise of the Oregon and Washington walnut industry which was a respectable size ten years ago, and has now dwindled to a mere handful of orchards, has resulted mainly from tremendous production technology advances in California where high-yielding lateral-bearing varieties have been developed. These varieties, unlike the tip-bearing varieties which grow in the Pacific Northwest, bloom and leaf out too early in the year and are too tender for use in Oregon, Washington or British Columbia. California walnut trees yield twice as much crop as Oregon trees and nearly three times as much as British Columbia trees, making it virtually impossible for Pacific Northwest growers to compete, except at farm or local sale prices.

Canada Land Inventory data indicate that there are many acres of well-drained soil suitable for tree nut production in the South Coastal, Okanagan and Kootenay areas. Soil type and availability are not in themselves constraints to the expansion of the nut industry. Land values, however, are very high and returns to land investment from nuts make it difficult to justify planting this crop in some districts.

Production requirements for filberts are easily met in the South Coastal area but climatic constraints raise some questions about their suitability in Interior districts. Because of the long time required to get walnuts into full bearing and the likelihood of winter freeze damage sometime in the interval, this crop remains a questionable one at least until reliably hardy, more productive varieties have been demonstrated commercially.

One of the most appealing things about nut growing as a farm enterprise is the fact that it can be fully mechanized. It is quite possible for one operator to undertake almost all of the management and care of a 40 to 60 acre orchard.

Nut farming on a smaller scale also lends itself to part-time farming owing to the rather low requirement for detailed laborious orchard work. Cost of machinery and equipment for a fully mechanized operation however, is quite high, as are custom service charges for flailing, sweeping, harvesting and drying.

The main constraints to production of nuts are the long time required for the trees to reach full bearing, winter and spring frost damage to catkins and female flowers with resulting light yields, winter freeze damage to trees, and high investment cost in land, buildings, machinery and equipment.

Drying and storage requirements for nuts are rather exacting. Both must be met to ensure high quality marketable nuts. Various types of drying equipment are used but all have the common principle of circulating warm air through a mass of "green" nuts in order to lower the moisture content of the kernels to around nine per cent. At this level, the nuts will keep for a year or more depending on the temperature at which they are stored, temperatures just above the freezing level being best for long storage.

Modest expansion of filbert tonnage in the Fraser Valley could be accommodated by existing drying facilities. If however, the tonnage were to increase to more than double the present 300 ton volume, additional drying and storage facilities would have to be built. This extra capacity could be provided either through expansion of existing facilities or erection of new ones,either on farm or cooperatively.

Nut buyers are generally satisfied with the quality of B.C. grown nuts, although they would encourage better quality control to ensure a more uniform product. It appears that there is plenty of room for more B.C. grown filberts. Buyers agree however, that B.C. cannot compete with California for the available walnut business.

At present there is no marketing organization for nut crops in B.C. Growers and buyers meet as individuals to establish prices and delivery arrangements. All B.C.-grown nuts are currently sold in B.C. and the prairie provinces, although records show that substantial shipments have been made to the U.S. in years past. Walnuts and sweet chestnuts are not sold through commercial channels as the available supplies are sufficient only for home use and sometimes the u pick trade.

Although startup costs for a nut orchard are quite high, it is apparent from the cost of production model that, after debt servicing charges are added at 12% interest and discount rate calculated at 10%, a filbert orchard of this size can be expected to yield a small return to operator labour, management, and land, building and equipment investment by the 10th year. When in full bearing at 12 years of age, a 60 acre orchard in the South Coastal area is seen to realize a gross return of $96,000 and a $59,113 return after expenses in that year. Using the discount rate of 10% and calculating interest on investment at 12%, however, the return to operator labour, management and land investment drops to $7618. A fully mechanized orchard such as this has a very low requirement for hired labour.

In the Okanagan and Kootenays, cost of production is slightly higher owing mainly to the necessity for irrigation. Returns are therefore lower in those areas.

The cost of production picture on walnuts is less attractive than on filberts. Calculating returns at wholesale prices currently being offered, there is never sufficient return from this 30 acre orchard in the South Coastal area to realize a return on the operator's investment. Even a full bearing orchard at 20 years of age realizes a negative return to operator labour, management and land, building and equipment investment. The main problem is low yield and low wholesale price. Using a farm gate price of $1.50 per pound which is almost double the wholesale offering, changes the picture substantially but still leaves walnuts an unattractive alternative to other crops.

Trade statistics suggest that an additional 700 to 800 acres of filberts at least would be required to replace the current volume of imported unshelled hazelnuts entering Canada. At the present time, it is with the unshelled product that the best opportunity for import replacement exists.

REFERENCES

(1) A brief History of the Nut Industry in British Columbia. W.S. Peters. 1976

(2) Agriculture Profiles of B.C. Centres, ARDSA Project 271024. 1980

(3) Apples - Cost of Establishment and Production. B.C.F.A. 1982

(4) A Study of the Agricultural Resources and Potentials of the British Columbia Gulf Islands. S.G. Preston. 1976

(5) B.C. Food and Beverage Processors Directory, BCMAF. 1983

(6) Bulletin Area Publications. B.C. Dept. of Lands, Forests & Water Resources. 1970

(7) Canadian Consensus Grape Costs and Returns. BCMAF. 1982

(8) Canadian Tariff Schedules. 1982

(9) Chestnuts, Almonds and Pecans. E.R. Hall, Agriculture Canada Research Station, Saanichton, 1940

(10) Climate of B.C. B.C. Ministry of Environment. 1950-1980

(11) Determining Fertilizer Requirements for Filberts. Ag. Canada. 1984

(12) Drying Walnuts. J.J. Woods, Agriculture Canada Research Station Saanichton 1941.

(13) Enterprise Data Sheet - Filberts. 1979

(14) Enterprise Data Sheet - Walnuts - Oregon State University. 1971

(15) Estimated Costs and Returns - Apple Orchard Establishment and Production. BCMAF. 1982

(16) Farm Land Valuation Schedules. B.C. Assessment Authority. 1984

(17) Farm Sales in B.C. B.C. Land Registry Office. 1981-83

(18) Filbert Analyzing by Leaf Analysis. Agassiz Research Station. 1983

(19) Filbert Growing in Washington. J.C. Snyder. State College of Washington. 1943

(20) Growing Filberts in Oregon. Baron & Stebbins, Oregon State University. 1981

(21) Growing Walnuts in the Pacific Northwest. Pacific Northwest Extension Publication. 1983

(22) Horticultural News Letters. BCMAF. 1949-80

(23) Imports by Commodities and Countries. Dept. Industry, Trade & Commerce. 1979-83

(24) Imports of Food Products Through B.C. Custom Ports. Dept. of Economic Development. 1979-83.

(25) Imports of Food Products by Canada. Dept. of Economic Development. 1979-83

(26) In Oregon Orchards. Robt. L. Stebbins. Oregon State University. 1983

(27) Nursery Price List. Pierce & Sons. Dundee Oregon. 1984-85.

(28) Nursery Price List. Wm. Gellatly Nursery, Westbank, B.C. 1983

(29) Nut Culture in British Columbia. E. Clarke. 1948

(30) Nut Culture. E.R. Hall, Dominion Experimental Station, Saanichton. 1951

(31) Nut Culture in British Columbia. Welsh & Peters, BCMAF. 1984

(32) Nut Growers Handbook. Carroll D. Bush. 1953

(33) Nut Growers Society of Oregon, Washington and British Columbia Handbook. 1983

(34) Oregon Agricultural Statistics. Oregon Dept. Agr. 1982-83

(35) Oregon Grade Standards for Filberts. 1980

(36) Planting the Hazelnut Orchard. Barcelona Nut Farm, R & H Wigand. 1983

(37) Produce Buying Guide. Blue Goose. 1980

(38) Producers Consensus Grape Costs and Returns. BCMAF. 1982

(39) Production of Berry Crops Grapes and Filberts Together with an Estimate of Farm Value. BCMAF. 1961-1983

(40) Progress in Hazelnut Production. Oregon State University. 1983

(41) Quarantine Circulars. Canada Dept. of Agric. 1974

(42) Soils Report - Okanagan & Similkameen Valleys. BCMAF. 1951

(43) The Cultivation of Walnuts. J.J. Woods, Saanichton Research Stn. 1943

(44) The Gellatly Pioneers, Daily Colonist, Victoria, B.C. June 1971

(45) Tree Fruit Production Guide. BCMAF. 1983

APPENDIX A

FILBERT COST OF PRODUCTION

APPENDIX A

ESTIMATED COSTS AND RETURNS FOR A FILBERT ORCHARD

I N D E X

	PAGE
Background Information and Assumptions	1
Investment Schedule	5
Per Acre Costs - South Coastal Area - Establishment Years	6-26
Per Acre Costs - South Coastal Area - Full bearing orchard	27
Summary of Costs & Returns - South Coastal Area	29
Per Acre Costs - Okanagan and Kootenay Areas	30

ESTIMATED COSTS AND RETURNS FOR A FILBERT ORCHARD

This cost of production study is based on a hypothetical filbert orchard in the Lower Fraser Valley. It is intended solely as a reference and is not intended to be representative of any specific orchard.

The basic data used in the study was obtained from four of the larger filbert growers in the greater Chilliwack area. This was supplemented with information from the provincial nut specialist, Mr. W.S. Peters, and agribusiness equipment and supply dealers. Input costs from the May/1984 Ministry of Agriculture & Food Input Cost Survey were also used. Further information was obtained from the B.C. Farm Income Insurance program and from growers and agribusiness in Oregon State.

Naturally, orchard conditions will vary from one orchard to another in terms of production practices, productivity, investment costs and management practices. The costs in any specific orchard will therefore vary from those cited in this study. Each individual grower will allocate returns to meet his own needs and therefore to determine his own return to investment. The discounted cash flow method is used in this study to determine return to operator labour, management, and investment in land, buildings and equipment.

Background information and Assumptions

(1) The following costs represent those on a hypothetical 60 acre filbert orchard in the Lower Fraser Valley. Duchilly is the main crop variety with Daviana as pollenizers. 60 acres was chosen as a suitably sized operation for an owner-operator to handle.

(2) Modern equipment and facilities and up-to-date cultural practices are assumed.

(3) Farm machinery and equipment is assumed to be purchased when first needed and is not all purchased when the orchard is first planted.

(4) The orchard is planted at a tree spacing of 10' x 20' with a view to thinning to a 20' x 20' spacing at 11 years of age. The transition to the 20' x 20' spacing is achieved by gradually pruning back every other tree (the filler trees) in the double spaced rows so that the permanent trees grow to their full stature. In this way, the benefit of extra yield from the filler trees is gained without adversely affecting the permanent trees. The multi-trunk system is used. Planting the young orchard therefore required 216 trees per acre. At full maturity, the orchard will contain 108 trees per acre. Augering for tree planting is custom done.

(5) Since filbert trees and specialized nut handling equipment are available in quantity only in the United States, it is assumed that these items are purchased in the United States at the rate of $1.30 Canadian for each U.S. dollar value and that these items enter Canada duty free. Except as otherwise noted, values quoted are in Canadian dollars.

(6) Owing to the longevity of filbert trees, no orchard renovation is anticipated. However, for purposes of integrating the individual establishment years and a full production year, methodology which takes into account streams of expected costs and returns over a 30 year period has been used.

(7) The new ground is levelled and rototilled at planting time, and grass and weeds which grow between the rows are flailed regularly to maintain a clean level orchard floor for mechanical harvesting.

(8) Chemical weed control is used around the trees. A hand sprayer is used in the early years while suckering is occurring and a power sprayer later when the orchard is in bearing habit.

(9) Trees are headed and trunks painted after planting and painted in the second year as well.

(10) Input costs are based on the most recent B.C. Ministry of Agriculture and Food Cost Survey (May 1984) and supplemented with quotations from Fraser Valley suppliers.

(11) Returns from the orchard are assumed to commence in the third year on a "pick your own" basis and continue this way until the sixth year, when mechanical harvesting begins.

(12) Yield per acre assumptions are as follows: (dry weight basis)

Years 1 & 2	No Yield	Year 7	800
3	75 lbs.	8	1000
4	200 lbs.	9	1200
5	400 lbs.	10	1400
6	600 lbs.	11	1600
		12	2000

Removal of filler trees in 11th year is unlikely to reduce orchard yield, as filler trees have been progressively pruned back each year to allow permanent trees to gain full stature and yield potential.

(13) Harvesting costs are based on ownership of machinery rather than custom charges.

(14) Charges for helicopter, tote bins, and hauling are on a custom service basis.

(15) Washing, drying and processing costs are based on ownership of on-farm facilities rather than custom charges. The equipment purchased for this operation is a $13,000 cleaning line (from Oregon Orchard Equipment), a $14,300 Butler bin type drier, and $8,000 in accessories. An additional $5,000 is allowed for the required building and concrete pad. Nuts for processing are Duchilly and are assumed to contain 25% moisture and 5% debris by weight when delivered from the orchard. Natural gas rather than propane is used as the heat source.

(16) Filbert prices used in this study are those obtained from contact with the buying trade and producer-vendors and are considered to be a modal average in recent years.

(17) Orchard floor maintenance includes gopher control, levelling, and other periodic operations.

(18) Pruning and removal costs are based on pruning 1/3 of the orchard annually.

(19) Minor element spray costs are calculated on the basis of spraying every second year in the bearing orchard.

(20) A maintenance liming application is made every fourth year.

(21) Interest on operating capital is calculated at 50% of the cost of cultural operations for the full year. Interest is calculated at 12.0%.

(22) Repair and maintenance costs are calculated for each piece of equipment as a percentage of its purchase price per hundred hours of operation. The formula used to calculate R&M cost is:

$$\frac{\text{Purchase Price of Equipment} \times \text{R\&M}}{100 \text{ hours}} \times \text{Hours of equipment usage}$$

Thus for a tractor costing $20,000 which is used in an operation for 1 hour the R&M cost would be:

$$\frac{\$20{,}000 \times .01}{100} \times 1 \text{ hour} = \$2.00$$

The R&M factors for each price of equipment used in the model is:

Machine	R&M Factor/100 hr
50 H.P. Tractor	1.0%
Pickup Truck	3.0%
Box Trailer	2.0%
Leveller	4.8%
Sweeper	3.0%
Flail	4.8%
Picker	3.0%
Brush Rake	2.4%
Weed Sprayer	2.0%
Fertilizer Spreader	2.0%
Girette	4.8%
300 Gallon Sprayer	2.0%
Cleaning Line	

(23) Fuel and oil costs are calculated based on the rate of fuel consumed per hour for each maximum horsepower rating of the power equipment used, plus 15% to account for oil. Diesel engines are assumed to use .0474 Imperial gallons per hour per horsepower, while gasoline engines are assumed to use .0741 Imperial gallons per hour per horsepower.

The formula used to calculate the fuel and oil cost is:

Fuel used per H.P. per hr. x H.P. x Hours Usage x Fuel Price x 1.15

Thus for the 50 H.P. tractor in the model used for one hour with a fuel cost of .41 per litre the cost would be:

.0474 x 50 H.P. x 1 Hr. x .41 x 1.15 = $5.08/hour

INVESTMENT SCHEDULE - FILBERT ORCHARD - 1984

Location: Fraser Valley
Size: 60 acres

EQUIPMENT (12 Yr Dep.)	Year Purchased	Purchase Price	Salvage Value	Depreciation (per Acre)	Return To Investment (per Acre)
50 H.P. wheel Tractor	1	$20,000.00	$8,000.00	$16.67	$17.50
Pick-up Truck (1/2 ton)	1	9,500.00	1,000.00	11.81	6.56
Box Trailer	6	1,033.00	150.00	1.23	0.74
Leveler	1	1,500.00	500.00	1.39	1.25
7.5 ft. Sweeper (30 H.P.)	6	15,600.00	3,000.00	17.50	11.63
9 ft. Flail (PTO)	1	4,550.00	1,500.00	4.24	3.78
Picker (50 H.P.)	6	13,000.00	3,500.00	13.19	10.31
Brush Rake	6	500.00	250.00	0.35	0.47
75 gal Weed Sprayer (PTO)	1	800.00	200.00	0.83	0.63
Fert. Spreader (w/ band attch)	1	750.00	150.00	0.83	0.56
Girette & Attch (12 H.P.)	8	5,300.00	1,000.00	5.97	3.94
300 gal Sprayer (PTO)	1	6,400.00	2,500.00	5.42	5.56
Small Tools & Orchard Equip. ‡	1	2,500.00	500.00	2.78	1.88
Subtotal - Equipment		$81,433.00	$22,250.00	$82.20	$64.80
BUILDINGS & APPURTENANCES (20 Yr Dep.)					
Implement Shed & Shop	1	$8,000.00	$400.00	$6.33	$5.25
Cleaning & Drying Facilities	6	40,300.00	15,000.00	21.08	34.56
Fuel Tanks	1	700.00	200.00	0.42	0.56
Subtotal - Buildings & Equipment		$49,000.00	$15,600.00	$27.83	$40.38
TOTAL CAPITAL INVESTMENT		$130,433.00	$37,850.00	$110.03	$105.18

‡ Includes items such as pruning tools, chainsaw, ladders, hand sprayer and miscellaneous equipment.

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 1 - Per Acre Cost

Location: Fraser Valley
Size: 80 acres 216 trees per acre 10' x 20' spacing
Hired Labour Rate: $5.57/hour (includes statutory benefits & W.C.B. costs)

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour (Hrs) Operator	Fuel & Oil	R & M	Materials		Total
Land Prep - Rotovating (Custom)		1							$70.00
Liming	50	1		0.50	$2.48	$1.08	2000 lbs @ $0.019 =	38.00	41.55
Staking		1	2.00	2.00			216 @ $0.02 =	4.32	4.32
Augering (Custom)		1					216 @ $0.40 =	86.40	86.40
Trees & Planting (4-5' 1/2 in. caliper)		1	9.00	9.00			216 @ $3.90 =	842.40	842.40
Fertilizing	50	1					432 starter tablets @ $0.05 =	21.60	21.60
Sunscald Protection				1.00			1 litre white latex paint @	3.75	3.75
Flailing	50	4		1.00	4.96	4.18			9.14
Hand Hoeing		2		10.80					
Use of Pickup				4.00	20.58	11.40			31.98
			11.00	28.30	$28.01	$16.66			$1111.14

VARIABLE CASH COSTS

Cultural Costs		$1111.14
Hired Labour: 11 hrs		61.24
R & M on Buildings & Appurtenances		2.90
Total Variable Cash Costs		$1175.28

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	15.38	
Interest on Operating Capital	73.45	
Legal & Accounting	8.33	
Total Non-Variable Cash Costs		138.17
		$1313.45
2% Overhead		26.27

Total Cash Costs	$1339.72
Expected Market Return	0.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	($1339.72)

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 2 - Per Acre Cost

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing

OPERATION	H.P.	Tiers	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	0.75				
Sunscald Protection		1	1.00			1 litre white latex paint @ 3.75	$3.75
Replanting (2%)		1	0.50			4 trees @ $3.90 = 15.60	15.60
Herbicide Spraying	50	2	1.00	$4.96	$2.16	Paraquat 2 L @ $18.25 = 36.50	43.62
Insecticide Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lb @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	150 lb 34-0-0 @ $0.114 300 lb 0-0-60 @ $0.111 = 50.40	53.95
Liming	50	1	0.50	2.48	1.08	1000 lbs @ $0.019 = 17.00	22.55
Flailing	50	4	1.00	4.96	4.18		9.14
Use of Pickup			2.00	10.29	5.70		15.99
			7.75	$27.63	$15.83		$177.47

VARIABLE CASH COSTS

Cultural Costs		$177.47
R & M on Buildings & Appurtenances		2.90
Total Variable Cash Costs		$180.37

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	15.38	
Interest on Operating Capital	11.27	
Legal & Accounting	8.33	
Total Non-Variable Cash Costs		75.99
		$256.36
2% Overhead		5.13
Total Cash Costs		$261.49

Expected Market Return	0.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	($261.49)

1994 FILBERT ORCHARD ESTABLISHMENT - YEAR 3 - Per Acre Cost

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	0.75				
Replanting (1%)		1	0.30			2 trees @ $3.90 = 7.80	$7.80
Herbicide Spraying	50	2	1.00	$4.96	$3.28	Paraquat 2 L @ $18.25 = 36.50	$4.74
Insecticide Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lb @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	200 lb 34-0-0 @ $0.114 300 lb 0-0-60 @ $0.111 = 56.10	59.65
Flailing	50	4	1.50	7.43	6.28		13.71
Soil & Leaf Analysis			0.10			$1.00 per acre	1.00
Suckering		1	1.00				
Minor Element	50	1	0.50	2.48	1.64	Borospray 5 lbs @ $0.80 = 4.00	8.12
Use of Pickup			2.00	10.29	5.70		15.99
			8.15	$30.11	$19.61		$167.62

VARIABLE CASH COSTS

Cultural Costs	$167.62
R & M on Buildings & Appurtenances	2.90
Total Variable Cash Costs	$170.52

NON-VARIABLE CASH COSTS

Taxes	$41.00
Insurance	15.38
Interest on Operating Capital	10.66
Legal & Accounting	8.33
Total Non-Variable Cash Costs	75.37
	$245.90
2% Overhead	4.92
Total Cash Costs	$250.82

Expected Market Return: First Crop (U-Pick) 75 lbs @ $0.90	60.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	($190.82)

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 4 - Per Acre Cost

Yield: 200 lbs

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	1.00				
Herbicide Spraying	50	2	1.00	$4.96	$3.28	Paraquat 2 L @ $18.25 = 36.50	$44.74
Insecticide Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lb @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	200 lb 34-0-0 @ $0.114 300 lb 0-0-60 @ $0.111 = 56.10	59.65
Flailing	50	7	1.75	8.67	7.32		16.00
Suckering		1	1.00				
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Use of Pickup			2.00	10.29	5.70		15.99
			9.75	$38.79	$23.22		$167.10

VARIABLE CASH COSTS

Cultural Costs	$167.10
R & M on Buildings & Appurtenances	2.90
Total Variable Cash Costs	$170.00

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	15.38	
Interest on Operating Capital	10.63	
Legal & Accounting	8.33	
Total Non-Variable Cash Costs		75.34
		$245.34
2% Overhead		4.91
Total Cash Costs		$250.25
Expected Market Return: Year Four Crop (U-Pick) 200 lbs @ $0.80		160.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		($90.25)

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 5 - Per Acre Cost

Yield: 400 lbs

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Reaoval		1	1.00				
Herbicide Spraying	50	2	1.00	$4.96	$3.28	Paraquat 2 L @ $18.25 = 36.50	$44.74
Insecticide Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lb @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	200 lb 34-0-0 @ $0.114 300 lb 0-0-60 @ $0.111 = 56.10	59.65
Liming	50	1	0.50	2.48	1.08	2000 lbs @ $0.019 = 38.00	41.55
Flailing	50	7	1.75	4.67	7.32		16.00
Suckering		1	1.00				
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Use of Pickup			2.00	10.29	5.70		15.99
			10.25	$41.26	$24.29		$208.66

VARIABLE CASH COSTS

Cultural Costs		$208.66
R & M on Buildings & Appurtenances		2.90
Total Variable Cash Costs		$211.56

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	15.38	
Interest on Operating Capital	13.22	
Legal & Accounting	8.33	
Total Non-Variable Cash Costs		77.94
		$289.49
2% Overhead		5.79
Total Cash Costs		$295.28
Expected Market Return: Year Five Crop (U-Pick) 400 lbs @ $0.80		320.00

Return to Operator Labour, Management and Land, Building & Equipment Investment	$24.72

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 6 - Per Acre Cost

Yield: 600 lbs

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing
Hired Labour Rate: $5.57/hour

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour	Fuel & Oil	R & M	Materials		Total
Pruning & Removal		1		1.10					
Herbicide Spraying	50	2		1.00	$4.96	$3.28	Paraquat 2 L @ $18.25		
							=	36.50	$44.74
Insecticide Spraying	50	1		0.50	2.48	1.64	Basudin 2.5 lb @ $5.00		
							=	12.50	16.62
Fertilizing	50	1		0.50	2.48	1.08	250 lb 34-0-0 @ $0.114		
							300 lb 0-0-60 @ $0.111		
							=	61.80	65.35
Flailing	50	7		1.75	8.67	7.32			16.00
Suckering		1		1.00					
Minor Element Spray	50	1		0.50	2.48	1.64	Borospray 5 lbs @ $0.80		
							=	4.00	8.12
Orchard Floor Maintenance	50	1		2.00	9.91	4.20			14.11
Sweeping	30	1		1.50	4.57	7.02			11.59
Helicopter Rental		1					2 minutes @ $7.50		
							=	15.00	15.00
Picking & Handling	50	1		2.00	9.91	7.80	Container Rental @ $6/		
							acre =	6.00	23.71
Hauling							600 lbs @ $0.01		6.00
Processing, Drying & Marketing			3.84	2.50			Natural Gas =	14.40	
							Electricity =	0.90	
							12 Sacks @ $0.65		
							=	7.80	23.10
Use of Pickup				2.00	10.29	5.70			15.99
			3.84	16.35	$55.75	$39.68			$260.32

VARIABLE CASH COSTS

Cultural Costs	$260.32
Hired Labour	21.38
R & M on Buildings & Appurtenances	16.33
Total Variable Cash Costs	$298.04

NON-VARIABLE CASH COSTS

Taxes	$41.00
Insurance	21.52
Interest on Operating Capital	18.63

Legal & Accounting	8.33	
Total Non-Variable Cash Costs		89.49
		$387.52
2% Overhead		7.75
Total Cash Costs		$395.27
Expected Market Return: Sixth Year Partial Crop 600 lbs @ $0.80		480.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$84.73

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 7 - Per Acre Cost

Yield: 800 lbs

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing
Hired Labour Rate: $5.57/hour

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour	Fuel & Oil	R & M	Materials		Total
Pruning & Removal		1		1.10					
Herbicide Spraying	50	2		1.00	$4.96	$3.28	Paraquat 2 L @ $18.25		
							"	36.50	$44.74
Insecticide Spraying	50	1		0.50	2.48	1.64	Basudin 2.5 lb @ $5.00		
							"	12.50	16.62
Fertilizing	50	1		0.50	2.48	1.08	250 lb 34-0-0 @ $0.114		
							300 lb 0-0-60 @ $0.111		
							"	61.80	65.35
Flailing	50	7		1.75	8.67	7.32			16.00
Soil & Leaf Analysis		1		0.10			$1.00/acre		1.00
Suckering		1		1.00					
Orchard Floor Maintenance	50	1		2.00	9.91	4.20			14.11
Sweeping	30	1		1.50	4.57	7.02			11.59
Helicopter Rental		1					2 minutes @ $7.50		
							"	15.00	15.00
Picking & Handling	50	1		2.00	9.91	7.80	Container Rental @ $8/		
							acre "	8.00	25.71
Hauling							800 lbs @ $0.01		8.00
Processing, Drying & Marketing			5.12	3.25			Natural Gas "	19.20	
							Electricity "	1.20	
							16 Sacks @ $0.65		
							"	10.40	30.80
Use of Pickup				2.00	10.29	5.70			15.99
			5.12	16.70	$53.27	$38.04			$264.91

VARIABLE CASH COSTS

Cultural Costs	$264.91
Hired Labour	28.50
R & M on Buildings & Appurtenances	16.33
Total Variable Cash Costs	$309.74

NON-VARIABLE CASH COSTS

Taxes	$41.00
Insurance	21.52
Interest on Operating Capital	19.36
Legal & Accounting	8.33

Total Non-Variable Cash Costs	90.22
	$399.96
2% Overhead	8.00
Total Cash Costs	$407.96
Expected Market Return: Seventh Year Partial Crop 800 lbs @ $0.80	640.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	$232.04

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 8 - Per Acre Cost

Yield: 1000 lbs

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing
Hired Labour Rate: $5.57/hour

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour	Fuel & Oil	R & M	Materials		Total
Pruning & Removal		1		1.20	$1.46	$3.05			$4.52
Herbicide Spraying	50	2		1.00	4.96	3.28	Paraquat 2 L @ $18.25 =	36.50	44.74
Insecticide Spraying	50	1		0.50	2.48	1.64	Basudin 2.5 lb @ $5.00 =	12.50	16.62
Fertilizing	50	1		0.50	2.48	1.08	275 lb 34-0-0 @ $0.114 300 lb 0-0-60 @ $0.111 =	64.65	68.20
Flailing	50	7		1.75	8.67	7.32			16.00
Suckering		1		1.00					
Orchard Floor Maintenance	50	1		2.00	9.91	4.20			14.11
Sweeping	30	1		1.50	4.57	7.02			11.59
Helicopter Rental		1					2 minutes @ $7.50 =	15.00	15.00
Picking & Handling	50	1		2.00	9.91	7.80	Container Rental @ $10/acre =	10.00	27.71
Hauling							1000 lbs @ $0.01		10.00
Processing, Drying & Marketing			6.40	4.00			Natural Gas = 24.00 Electricity = 1.50 20 Sacks @ $0.65 =	13.00	38.50
Use of Pickup				2.00	10.29	5.70			15.99
			6.40	17.45	$53.27	$38.04			$282.97

VARIABLE CASH COSTS

Cultural Costs	$282.97
Hired Labour	35.63
R & M on Buildings & Appurtenances	16.33
Total Variable Cash Costs	$334.94

NON-VARIABLE CASH COSTS

Taxes	$41.00
Insurance	21.79
Interest on Operating Capital	20.93
Legal & Accounting	8.33

Total Non-Variable Cash Costs	92.06
	$426.99
2% Overhead	8.54
Total Cash Costs	$435.53
Expected Market Return: Eighth Year Partial Crop 1000 lbs @ $0.80	800.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	$364.47

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 9 - Per Acre Cost

Yield: 1200 lbs

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing
Hired Labour Rate: $5.57/hour

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour	Fuel & Oil	R & M	Materials		Total
Pruning & Removal	12	1		1.10	$1.34	$2.80			$4.14
Herbicide Spraying	50	2		1.00	4.96	3.28	Paraquat 2 L @ $18.25 =	36.50	44.74
Insecticide Spraying	50	1		0.50	2.48	1.64	Basudin 2.5 lb @ $5.00 =	12.50	16.62
Fertilizing	50	1		0.50	2.48	1.08	275 lb 34-0-0 @ $0.114 300 lb 0-0-60 @ $0.111 =	64.65	69.20
Liming	50	1		0.50	2.48	1.08	2000 lbs @ $0.019 =	38.00	41.55
Flailing	50	7		1.75	8.67	7.32			16.00
Suckering		1		1.00					
Minor Element Spray	50	1		0.50	2.48	1.64	Borospray 5 lb @ $0.80 =	4.00	8.12
Orchard Floor Maintenance	50	1		2.00	9.91	4.20			14.11
Sweeping	30	1		1.50	4.57	7.02			11.59
Helicopter Rental		1					2 minutes @ $7.50 =	15.00	15.00
Picking & Handling	50	1		2.00	9.91	7.80	Container Rental @ $12/ acre =	12.00	29.71
Hauling							1200 lbs @ $0.01		12.00
Processing, Drying & Marketing			7.67	5.00			Natural Gas = 28.80 Electricity = 1.80 24 Sacks @ $0.65 =	15.60	46.20
Use of Pickup				2.00	10.29	5.70			15.99
			7.67	19.35	$58.23	$40.75			$343.97

VARIABLE CASH COSTS

Cultural Costs	$343.97
Hired Labour	42.70
R & M on Buildings & Appurtenances	16.33
Total Variable Cash Costs	$403.00

NON-VARIABLE CASH COSTS

Taxes	$41.00

Insurance	21.79	
Interest on Operating Capital	25.19	
Legal & Accounting	8.33	
	Total Non-Variable Cash Costs	96.31
		$499.31
	2% Overhead	9.99
	Total Cash Costs	$509.30
Expected Market Return: Ninth Year Partial Crop 1200 lbs @ $0.80		960.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$450.70

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 10 - Per Acre Cost

Yield: 1400 lbs

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing
Hired Labour Rate: $5.57/hour

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1		1.25	$1.52	$3.18		$4.70
Herbicide Spraying	50	2		1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insecticide Spraying	50	1		0.50	2.48	1.64	Basudin 2.5 lb @ $5.00 = 12.50	16.62
Fertilizing	50	1		0.50	2.48	1.08	300 lb 34-0-0 @ $0.114 300 lb 0-0-60 @ $0.111 = 67.50	71.06
Flailing	50	7		1.75	8.67	7.32		16.00
Suckering		1		1.00				
Orchard Floor Maintenance	50	1		2.00	9.91	4.20		14.11
Sweeping	30	1		1.50	4.57	7.02		11.59
Helicopter Rental		1					2 minutes @ $7.50 = 15.00	15.00
Picking & Handling	50	1		2.50	12.39	9.75	Container Rental @ $14/acre = 14.00	36.14
Hauling							1400 lbs @ $0.01	14.00
Processing, Drying & Marketing			8.96	5.50			Natural Gas = 33.60 Electricity = 2.10 28 Sacks @ $0.65 = 18.20	53.90
Use of Pickup				2.00	10.29	5.70		15.99
			8.96	19.50	$55.75	$39.99		$313.84

VARIABLE CASH COSTS

Cultural Costs	$313.84
Hired Labour	49.68
R & M on Buildings & Appurtenances	16.33
Total Variable Cash Costs	$380.05

NON-VARIABLE CASH COSTS

Taxes	$41.00
Insurance	21.79
Interest on Operating Capital	23.75
Legal & Accounting	8.33

Total Non-Variable Cash Costs	94.88
	$474.93
2% Overhead	9.50
Total Cash Costs	$484.43
Expected Market Return: Tenth Year Partial Crop 1400 lbs @ $0.80	1120.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	$635.57

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 11 - Per Acre Cost

Yield: 1600 lbs

Location: Fraser Valley
Size: 60 acres 216 trees per acre 10' x 20' spacing
Hired Labour Rate: $5.57/hour

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour (Hrs) Operator	Fuel & Oil	R & M	Materials	Total
Tree Removal				27.00				
Pruning & Removal	12	1		1.25	$1.52	$3.18		$4.70
Herbicide Spraying	50	2		1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insecticide Spraying	50	1		0.50	2.48	1.64	Basudin 2.5 lb @ $5.00 = 12.50	16.62
Fertilizing	50	1		0.50	2.48	1.08	350 lb 34-0-0 @ $0.114 400 lb 0-0-60 @ $0.111 = 84.30	87.86
Flailing	50	7		1.75	8.67	7.32		16.0[illegible]
Suckering		1		1.00				
Minor Element Spray	50	1		0.50	2.48	1.64	Borospray 5 lb @ $0.80 Mag. Sulphate @ $0.20 = 10.00	14.12
Orchard Floor Maintenance	50	1		2.00	9.91	4.20		14.11
Sweeping	30	1		1.50	4.57	7.02		11.59
Helicopter Rental		1					2 minutes @ $7.50 = 15.00	15.00
Picking & Handling	50	1		2.50	12.39	9.75	Container Rental @ $16/acre = 16.00	38.14
Hauling							1600 lbs @ $0.01	16.00
Processing, Drying & Marketing			10.24	6.50			Natural Gas = 38.40 Electricity = 2.40 32 Sacks @ $0.65 = 20.80	61.60
Use of Pickup				2.00	10.29	5.70		15.99
			10.24	21.00	$58.23	$41.63		$356.46

VARIABLE CASH COSTS

Cultural Costs	$356.46
Hired Labour	57.01
R & M on Buildings & Appurtenances	16.33
Total Variable Cash Costs	$429.80

NON-VARIABLE CASH COSTS

Taxes	$41.09

Insurance	21.79	
Interest on Operating Capital	26.86	
Legal & Accounting	8.33	
	Total Non-Variable Cash Costs	97.99
		$527.78
	2% Overhead	10.56
	Total Cash Costs	$538.34
Expected Market Return: Eleventh Year Partial Crop 1600 lbs @ $0.80		1280.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$741.66

1984 FILBERT ORCHARD ESTABLISHMENT - YEAR 12 and following years - Per Acre Cost

Yield: 2000 lbs

Location: Fraser Valley
Size: 60 acres 108 trees per acre 20' x 20' spacing
Hired Labour Rate: $5.57/hour

OPERATION	H.P.	Trees	Labour (Hrs) Hired	Labour (Hrs) Operator	Fuel & Oil	R & M	Materials		Total
Pruning & Removal	12	1		1.50	$1.83	$3.82			$5.64
Herbicide Spraying	50	2		1.00	4.96	3.28	Paraquat 2 L @ $18.25		
							Princep 80w 2.5 lb @		
							$6.00 =	$1.50	59.74
Insecticide Spraying	50	1		0.50	2.48	1.64	Basudin 2.5 lb @ $5.00		
							=	12.50	16.62
Fertilizing	50	1		0.50	2.48	1.08	400 lb 34-0-0 @ $0.114		
							400 lb 0-0-60 @ $0.111		
							=	90.00	93.55
Liming (every 4th year)	50	1		0.13	0.62	0.27	1000 lb @ $0.019		
							/4 =	4.75	5.64
Flailing	50	7		1.75	8.67	7.32			16.00
Soil & Leaf Analysis (every 4th yr)							$1.00/acre /4		0.25
Suckering		1		1.00					
Minor Element Spray (every 2nd yr)	50	1		0.25	1.24	0.82	Borospray 5 lb @ $0.80		
							Mag. Sulphate @ $0.20		
							/2 =	5.00	7.06
Orchard Floor Maintenance	50	1		2.00	9.91	4.20			14.11
Sweeping	30	1		1.50	4.57	7.02			11.59
Helicopter Rental		1					2 minutes @ $7.50		
							=	15.00	15.00
Picking & Handling	50	1		3.00	14.87	11.70	Container Rental @ $20/		
							acre =	20.00	46.57
Hauling							2000 lbs @ $0.01		20.00
Processing, Drying & Marketing			12.80	8.00			Natural Gas =	48.00	
							Electricity =	3.00	
							40 Sacks @ $0.65		
							=	26.00	77.00
Use of Pickup				3.00	15.43	8.55			23.98
			12.80	24.13	$65.23	$45.88			$412.75

VARIABLE CASH COSTS

Cultural Costs	$412.75
Hired Labour	71.26
R & M on Buildings & Appurtenances	16.33
Total Variable Cash Costs	$500.34

NON-VARIABLE CASH COSTS

==========

Taxes	$41.00	
Insurance	21.79	
Interest on Operating Capital	31.27	
Legal & Accounting	8.33	

	Total Non-Variable Cash Costs	102.39

		$602.74
	2% Overhead	12.05

	Total Cash Costs	$614.79
Expected Market Return: Full Production Crop 2000 lbs @ $0.80		1600.00

Return to Operator Labour, Management and Land, Building & Equipment Investment		$985.21

FILBERT ORCHARD SUMMARY

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Cash Income	$0.00	$0.00	$160.00	$160.00	$320.00	$480.00	$640.00	$800.00	$960.00	$1,120.00	$1,280.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00
Cash Operating Expenses	1,339.72	261.49	250.82	250.25	295.28	395.27	407.96	435.53	509.30	484.43	536.34	614.79	614.79	614.79	614.79
Add: Depreciation	50.71	50.71	50.71	50.71	50.71	104.06	104.06	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03
Interest	0	166.85	224.34	280.24	330.79	373.60	420.75	455.88	480.06	496.78	493.33	476.73	428.92	375.37	315.39
Total Cash Outflow	1,390.43	479.05	525.86	581.20	676.78	872.93	932.77	1,001.44	1,099.38	1,091.24	1,141.70	1,201.56	1,153.74	1,100.19	1,040.21
Net Cash Flow	($1,390.43)	($479.05)	($465.86)	($421.20)	($356.78)	($392.93)	($292.77)	($201.44)	($139.38)	$28.76	$138.30	$398.44	$446.26	$499.81	$559.79
Discounted Cash Flow	($1,264.03)	($395.91)	($350.01)	($287.69)	($221.53)	($221.80)	($150.24)	($93.98)	($59.11)	$11.09	$48.47	$126.96	$129.26	$131.62	$134.01

	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Cash Income	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00
Cash Operating Expenses	614.79	614.79	614.79	614.79	614.79	614.79	614.79	614.79	614.79	614.79	614.79	614.79	614.79	614.79	614.79
Add: Depreciation	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03	110.03
Interest	248.22	172.98	88.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Cash Outflow	973.04	897.81	813.54	724.82	724.82	724.82	724.82	724.82	724.82	724.82	724.82	724.82	724.82	724.82	724.82
Net Cash Flow	$626.96	$702.19	$786.46	$875.18	$875.18	$875.18	$875.18	$875.18	$875.18	$875.18	$875.18	$875.18	$875.18	$875.18	$875.18
Discounted Cash Flow	$136.44	$138.93	$141.45	$143.10	$130.09	$118.26	$107.51	$97.74	$88.85	$80.78	$73.43	$66.76	$60.69	$55.17	$50.16

Summed Net Present Value ($973.52)

1984 FILBERT ORCHARD

Cost per Acre - Okanagan and Kootenay

The costs of establishing and maintaining a filbert orchard in the Okanagan and Kootenay regions are somewhat higher than those for the Lower Fraser Valley. This is due mainly to the need for irrigation in these regions. Fuel and transportation costs are also slightly higher. Machinery and equipment inventory is otherwise the same.

A portable sprinkler irrigation system for a 60 acre orchard is assumed to cost $24,000. Depreciated over a 20 year period, the annual depreciation cost is $1200. Water cost is calculated at $55 per acre.

Operator labour for irrigating is calculated at 3.13 hours per acre per year and repairs and maintenance on the system at $12.55 per acre.

In all other respects the enterprise will be similar to the Fraser Valley model. As a result, the costs associated with a 60 acre filbert orchard in the Okanagan and Kootenay regions are as follows:

1984 FILBERT ORCHARD

Size: 60 acres

	Costs/Acre		Harvest	Costs/Acre	
	Okanagan	Kootenays	Return	Okanagan	Kootenays
Year 1	$1416.55	$1416.55	$0.00	($1416.55)	($1416.55)
Year 2	321.01	321.01	0.00	($321.01)	($321.01)
Year 3	311.87	311.87	60.00	($251.87)	($251.87)
Year 4	311.31	311.31	160.00	($151.31)	($151.31)
Year 5	357.90	357.90	320.00	($37.90)	($37.90)
Year 6	455.71	457.72	480.00	$24.29	$22.28
Year 7	466.98	469.58	640.00	$173.02	$170.42
Year 8	494.31	497.50	800.00	$305.69	$302.50
Year 9	568.41	572.21	960.00	$391.59	$387.79
Year 10	542.05	546.33	1120.00	$577.95	$573.67
Year 11	596.72	601.60	1280.00	$683.28	$678.40
Year 12 -	675.02	681.20	1600.00	$924.98	$918.80

APPENDIX B

WALNUT COST OF PRODUCTION

APPENDIX B

ESTIMATED COSTS AND RETURNS FOR A WALNUT ORCHARD

I N D E X

	PAGE
Background Information and Assumptions	2
Investment Schedule	3
Per Acre Costs - South Coastal Area - Establishment Years	4 - 23
Per Acre Costs - South Coastal Area - Full Bearing Orchard	24
Per Acre Costs - Okanagan and Kootenay Areas	27

ESTIMATED COSTS AND RETURNS FOR A WALNUT ORCHARD

This cost of production study is based on a hypothetical walnut orchard in the Lower Fraser Valley. It is intended solely as a reference and is not intended to be representative of any specific orchard.

Owing to the absence of walnut orchards in British Columbia, the basic data used in the study was obtained from two walnut growers in Oregon State and one in Washington State. This was supplemented with information gleaned from owners of small plantings of walnuts in the Fraser Valley and Okanagan areas. Agribusiness equipment and supply dealers supplied further information.

Since there are no commercial walnut orchards in British Columbia at the present time, it was not possible tostudy production practices, productivity, or investment costs locally. The costs in any specific orchard will undoubtedly vary from those cited in this study. Potential growers will allocate returns to meet their own needs and determine their own return to investment. The discounted cash flow method is used in this study to determine return to operator labour, management, and investment in land, buildings and equipment.

Background Information and Assumptions

(1) The following costs represent those on a hypothetical 30 acre walnut orchard in the Lower Fraser Valley. Franquette is the main crop variety with Broadview planted (one in five) for cross-pollination.

(2) Following initial preparation and levelling of the land, the nontillage system of orchard management is used. Weeds and grass are flailed regularly to conserve moisture and later to prepare a clean level orchard floor for harvesting.

(3) The orchard is planted at a tree spacing of 20' x 20' with a view to removing half the trees when they begin to crowd. Trees are trained to a single stem and filler trees when they begin to grow, are pruned back progressively to favour the permanent trees. For purposes of this study, tree removal occurs at the end of the 19th year.

(4) Farm machinery and equipment is purchased when first needed and is not all purchased when the orchard is first planted.

(5) Picking, hauling, processing and drying are done on a custom charge basis.

(6) Owing to the longevity of walnut trees, no renovation is anticipated. However for purposes of integrating the individual establishment years with a full production year methodology which takes into account streams of expected costs and returns over a 30 year period has been used.

(7) Chemical weed control is used around the trees. A hand sprayer is used while trees are young, a power sprayer later.

(8) Trees are staked when planted to offset wind damage.

(9) Commercial production is assumed to commence in the 10th year with trees reaching full bearing at 20 years. Yield per acre assumptions are as follows:

Years 1 - 5	No Yield	Year 13	625
6	100	14	700
7	150	15	800
8	225	16	950
9	300	17	1100
10	375	18	1200
11	450	19	1300
12	550	20 - 30	1500

(10) Harvesting is done mechanically on a custom basis from the 12th year on. Until the 12th year, nuts are harvested on a "U Pick" basis. Processing and Drying are also done on a custom basis commencing in the 12th year. Drying cost is based on forced air drying without heat down to 12% kernel moisture and natural gas heat to finish the drying process.

(11) Wholesale walnut prices used in this study are those obtained from the buying trade in Vancouver.

(12) Orchard floor maintenance includes levelling, rodent control, and other periodic operations.

INVESTMENT SCHEDULE - WALNUT ORCHARD - 1984

Location: Fraser Valley
Size: 30 acres

EQUIPMENT (12 Yr Dep.)	Year Purchased	Purchase Price	Salvage Value	Depreciation (per Acre)	Return To Investment (per Acre)
50 H.P. wheel Tractor	1	$20,000.00	$8,000.00	$33.33	$35.00
Pick-up Truck (1/2 ton)	1	9,500.00	1,000.00	23.61	13.13
Orchard Trailer	1	1,100.00	150.00	2.64	1.56
Leveler	1	1,500.00	500.00	2.78	2.50
9 ft. Flail (PTO)	1	4,350.00	1,500.00	8.47	7.56
Brush Rake	6	500.00	250.00	0.69	0.94
75 gal Weed Sprayer (PTO)	1	800.00	200.00	1.67	1.25
Fert. Spreader (w/ band attch)	1	750.00	150.00	1.67	1.13
Girette & Attch (12 H.P.)	8	5,300.00	1,000.00	11.94	7.88
300 gal Sprayer (PTO)	1	6,400.00	2,500.00	10.83	11.13
Small Tools & Orchard Equip. ‡	1	2,500.00	500.00	5.56	3.75
Subtotal - Equipment		$52,900.00	$15,750.00	$103.19	$85.81
BUILDINGS & APPURTENANCES (20 Yr Dep.)					
Implement Shed & Shop	1	$8,000.00	$400.00	$12.67	$10.50
Fuel Tanks	1	700.00	200.00	0.83	1.13
Subtotal - Buildings & Equipment		$8,700.00	$600.00	$13.50	$11.63
TOTAL CAPITAL INVESTMENT		$61,600.00	$16,350.00	$116.69	$97.44

‡ Includes items such as pruning tools, chainsaw, ladders, hand sprayer and miscellaneous equipment.

1994 WALNUT ORCHARD ESTABLISHMENT - YEAR 1 - Per Acre Cost

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing
Hired Labour Rate: $5.57/hour (includes statutory benefits & W.C.B. costs)

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour (Hrs) Operator	Fuel & Oil	R & M	Materials		Total
Land Prep - Rotovating (Custom)		1							$70.00
Liming	50	1		0.59	$2.48	$1.08	2000 lbs @ $0.019 =	38.00	41.55
Staking		1	1.00	1.00			108 @ $0.02 =	2.16	2.16
Augering (Custom)		1					108 @ $0.40 =	43.20	43.20
Trees & Planting (4-5' 1/2 in. caliper)		1	5.00	5.00			108 @ $5.00 =	540.00	540.00
Heading & Staking Trees		1	2.70	2.70			108 @ $0.25 =	27.00	
Fertilizing	50	1					216 starter tablets @ $0.05 =	10.80	10.80
Flailing	50	4		1.00	4.96	4.18			9.14
Hand Hoeing		2		5.40					
Use of Pickup				2.00	10.29	5.70			15.99
			8.70	17.60	$17.72	$10.96			$732.84

VARIABLE CASH COSTS

Cultural Costs	$732.84
Hired Labour	48.43
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$787.08

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	30.88	
Interest on Operating Capital	49.19	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		137.74
		$924.81

2% Overhead	16.50
Total Cash Costs	$943.31
Expected Market Return	0.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	($943.31)

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 2 - Per Acre Cost

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	1.00				
Herbicide Spraying (hand)		2	1.00			Paraquat 1.5 L @ $18.25 =	27.38 $27.38
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 =	12.50 16.62
Fertilizing (hand)		1	0.50			160 lbs 34-0-0 @ $0.114 =	18.24 18.24
Flailing	50	5	1.25	6.20	5.23		11.43
Replanting & Staking (2%)		1	0.50			2 trees @ $5.00 =	10.00 10.00
Use of Pickup			1.50	7.72	4.28		11.99
			6.25	$16.39	$11.15		$95.65

VARIABLE CASH COSTS

Cultural Costs	$95.65
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$101.45

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	30.88	
Interest on Operating Capital	6.34	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		94.88
		$196.33
2% Overhead		3.93
Total Cash Costs		$200.26
Expected Market Return		0.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		($200.26)

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 3 - Per Acre Cost

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	1.00				
Herbicide Spraying (hand)		2	1.00			Paraquat 1.5 L @ $18.25 = 27.38	$27.38
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing (hand)		1	0.50			160 lbs 34-0-0 @ $0.114 = 18.24	18.24
Flailing	50	5	1.25	6.20	5.23		11.43
Use of Pickup			1.50	7.72	4.28		11.99
			5.75	$16.39	$11.15		$85.65

VARIABLE CASH COSTS

Cultural Costs	$85.65
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$91.45

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	30.88	
Interest on Operating Capital	5.72	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		94.26
		$185.71
2% Overhead		3.71
Total Cash Costs		$189.42
Expected Market Return		0.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$(189.42)

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 4 - Per Acre Cost

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Trees	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	1.00				
Herbicide Spraying (hand)		2	1.00			Paraquat 1.5 L @ $18.25 = 27.38	$27.38
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing (hand)		1	0.50			160 lbs 34-0-0 @ $0.114 = 18.24	18.24
Flailing	50	5	1.25	6.20	5.23		11.43
Use of Pickup			1.50	7.72	4.28		11.99
			5.75	$16.39	$11.15		$85.65

VARIABLE CASH COSTS

Cultural Costs	$85.65
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$91.45

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	30.88	
Interest on Operating Capital	5.72	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		94.26
		$185.71
2% Overhead		3.71
Total Cash Costs		$189.42
Expected Market Return		0.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		($189.42)

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 5 - Per Acre Cost

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	1.00				
Herbicide Spraying (hand)		2	1.00			Paraquat 1.5 L @ $18.25 = 27.38	$27.38
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing (hand)		1	0.50			160 lbs 34-0-0 @ $0.114 = 18.24	18.24
Flailing	50	5	1.25	6.20	5.23		11.43
Use of Pickup			1.50	7.72	4.28		11.99
			5.75	$16.39	$11.15		$85.65

VARIABLE CASH COSTS

Cultural Costs	$85.65
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$91.45

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	30.88	
Interest on Operating Capital	5.72	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		94.26
		$185.71
2% Overhead		3.71
Total Cash Costs		$189.42
Expected Market Return		0.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		($189.42)

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 6 - Per Acre Cost

Yield: 100 lbs.

Location: Fraser Valley
Size: 30 acres 109 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	1.00				
Herbicide Spraying	50	2	1.00	$4.96	$3.28	Paraquat 2 L @ $18.25 = 36.50	$44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	250 lbs 34-0-0 @ $0.114 = 28.50	32.05
Liming	50	1	0.50	2.48	1.08	1000 lbs @ $0.019 = 19.00	22.55
Flailing	50	6	1.50	7.43	6.28		13.71
Use of Pickup			1.50	7.72	4.28		11.99
			6.50	$27.54	$17.62		$141.66

VARIABLE CASH COSTS

Cultural Costs	$141.66
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$147.46

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	30.93	
Interest on Operating Capital	9.22	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		97.81
		$245.27
2% Overhead		4.91
Total Cash Costs		$250.18
Expected Market Return: Year 6 Partial Crop (U-Pick) 100 lbs		100.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		($150.18)

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 7 - Per Acre Cost

Yield: 150 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal		1	1.00				
Herbicide Spraying	50	2	1.00	$4.96	$3.28	Paraquat 2 L @ $18.25 = 36.50	$44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	250 lbs 34-0-0 @ $0.114 = 28.50	32.05
Flailing	50	6	1.50	7.43	6.28		13.71
Use of Pickup			1.50	7.72	4.28		11.99
			6.00	$25.06	$16.55		$119.11

VARIABLE CASH COSTS

Cultural Costs	$119.11
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$124.91

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	30.93	
Interest on Operating Capital	7.81	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		96.40
		$221.31
2% Overhead		4.43
Total Cash Costs		$225.74
Expected Market Return: Year 7 Partial Crop (U-Pick) 150 lbs		150.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		($75.74)

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 8 - Per Acre Cost

Yield: 225 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	M.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	1.00	$1.22	$2.54		$3.76
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25	
						" 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00	
						" 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	250 lbs 34-0-0 @ $0.114	
						" 28.50	32.05
Flailing	50	6	1.50	7.43	6.28		13.71
Use of Pickup			1.50	7.72	4.28		11.99
			6.00	$26.28	$19.09		$122.87

VARIABLE CASH COSTS

Cultural Costs		$122.87
R & M on Buildings & Appurtenances		5.80
Total Variable Cash Costs		$128.67

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	8.04	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		97.17
		$225.84
2% Overhead		4.52
Total Cash Costs		$230.35
Expected Market Return: Year 8 Partial Crop (U-Pick) 225 lbs		225.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		($5.35)

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 9 - Per Acre Cost

Yield: 300 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Trees	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	1.00	$1.22	$2.54		$3.76
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 =	36.50 44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 =	12.50 16.62
Fertilizing	50	1	0.50	2.48	1.08	250 lbs 34-0-0 @ $0.114 =	28.50 32.05
Liming	50	1	0.50	2.48	1.08	1000 lbs @ $0.019 =	19.00 22.55
Flailing	50	6	1.50	7.43	6.28		13.71
Use of Pickup			1.50	7.72	4.28		11.99
			6.50	$28.76	$20.17		$145.42

VARIABLE CASH COSTS

Cultural Costs	$145.42
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$151.22

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	9.45	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		98.58
		$249.80
2% Overhead		5.00
Total Cash Costs		$254.80
Expected Market Return: Year 9 Partial Crop (U-Pick) 300 lbs		300.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$45.20

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 10 - Per Acre Cost

Yield: 375 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	1.00	$1.22	$2.54		$3.76
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	250 lbs 34-0-0 @ $0.114 = 28.50	32.05
Flailing	50	6	1.50	7.43	6.28		13.71
Use of Pickup			1.50	7.72	4.28		11.99
			6.00	$26.28	$19.09		$122.87

VARIABLE CASH COSTS

Cultural Costs	$122.87
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$128.67

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	8.04	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		97.17
		$225.84
2% Overhead		4.52
Total Cash Costs		$230.35
Expected Market Return: Year 10 Partial Crop (U-Pick) 375 lbs		375.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$144.65

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 11 - Per Acre Cost

Yield: 450 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	1.00	$1.22	$2.54		$3.76
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	250 lbs 34-0-0 @ $0.114 = 28.50	32.05
Flailing	50	1	1.50	7.43	6.28		13.71
Use of Pickup			1.50	7.72	4.28		11.99
			6.00	$26.28	$19.09		$122.87

VARIABLE CASH COSTS

Cultural Costs	$122.87
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$128.67

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	8.04	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		97.17
		$225.84
2% Overhead		4.52
Total Cash Costs		$230.35
Expected Market Return: Year 11 Partial Crop (U-Pick) 450 lbs		450.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$219.65

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 12 - Per Acre Cost

Yield: 550 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials		Total
Pruning & Removal	12	1	5.00	$6.10	$12.72			$18.82
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 =	36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 =	12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	400 lbs 34-0-0 @ $0.114 =	45.60	49.15
Flailing	50	7	1.50	7.43	6.28			13.71
Soil & Leaf Analysis		1	0.10			$1.00 per acre		1.00
Minor Element Spray	50	1	0.50	2.48	1.64	Borospray 5 lbs @ $0.80 =	4.00	8.12
Orchard Floor Maintenance	50	1	2.00	9.91	4.20			14.11
Sweeping, Picking & Hauling (custom)						$80.00 per acre		80.00
Processing, Drying & Marketing (custom)						550 lbs @ $0.15 11 sacks @ $0.65 =	89.65	89.65
Use of Pickup			1.50	7.72	4.28			11.99
			12.60	$43.55	$35.11			$347.90

VARIABLE CASH COSTS

Cultural Costs	$347.90
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$353.70

NON-VARIABLE CASH COSTS

Taxes	$41.00
Insurance	31.46
Interest on Operating Capital	22.11
Legal & Accounting	16.67
Total Non-Variable Cash Costs	111.23
	$464.94
2% Overhead	9.30
Total Cash Costs	$474.23
Expected Market Return: Year 12 Partial crop 550 lbs @ $0.85	467.50
Return to Operator Labour, Management and Land, Building & Equipment Investment	-6.73

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 13 - Per Acre Cost

Yield: 625 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	5.00	$6.10	$12.72		$18.82
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	400 lbs 34-0-0 @ $0.114 = 45.60	49.15
Liming	50	1	0.50	2.48	1.08	2000 lbs @ $0.019 = 38.00	41.55
Flailing	50	7	1.50	7.43	6.28		13.71
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Sweeping, Picking & Hauling (custom)						$80.00 per acre	80.00
Processing, Drying & Marketing (custom)						625 lbs @ $0.15 12.5 sacks @ $0.65 = 101.88	101.88
Use of Pickup			1.50	7.72	4.28		11.99
			12.50	$43.55	$34.54		$392.56

VARIABLE CASH COSTS

Cultural Costs	$392.56
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$398.36

NON-VARIABLE CASH COSTS

Taxes	$41.00
Insurance	31.46
Interest on Operating Capital	24.90
Legal & Accounting	16.67
Total Non-Variable Cash Costs	114.02
	$512.39
2% Overhead	10.25
Total Cash Costs	$522.63
Expected Market Return: Year 13 Partial crop 625 lbs @ $0.85	531.25
Return to Operator Labour, Management and Land, Building & Equipment Investment	$8.62

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 14 - Per Acre Cost

Yield: 700 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	5.00	$6.10	$12.72		$18.82
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	400 lbs 34-0-0 @ $0.114 = 45.60	49.15
Flailing	50	7	1.50	7.43	6.28		13.71
Minor Element Spray	50	1	0.50	2.48	1.64	Borospray 5 lbs @ $0.80 = 4.00	8.12
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Sweeping, Picking & Hauling (custom)						$80.00 per acre	80.00
Processing, Drying & Marketing (custom)						700 lbs @ $0.15 14 sacks @ $0.65 = 114.10	114.10
Use of Pickup			1.50	7.72	4.28		11.99
			12.50	$43.55	$35.11		$371.35

VARIABLE CASH COSTS

Cultural Costs	$371.35
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$377.15

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	23.57	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		112.70
		$489.85
2% Overhead		9.80
Total Cash Costs		$499.65
Expected Market Return: Year 14 Partial crop 700 lbs @ $0.85		595.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$95.35

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 15 - Per Acre Cost

Yield: 800 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	5.00	$6.10	$12.72		$18.82
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	400 lbs 34-0-0 @ $0.114 = 45.60	49.15
Flailing	50	7	1.50	7.43	6.28		13.71
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Sweeping, Picking & Hauling (custom)						$80.00 per acre	80.00
Processing, Drying & Marketing (custom)						800 lbs @ $0.15 16 sacks @ $0.65 = 130.40	130.40
Use of Pickup			1.50	7.72	4.28		11.99
			12.00	$41.07	$33.47		$379.54

VARIABLE CASH COSTS

Cultural Costs		$379.54
R & M on Buildings & Appurtenances		5.80
Total Variable Cash Costs		$385.34

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	24.08	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		113.21
		$498.54
2% Overhead		9.97
Total Cash Costs		$508.52
Expected Market Return: Year 15 Partial crop 800 lbs @ $0.85		680.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$171.48

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 16 - Per Acre Cost

Yield: 950 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	5.00	$6.10	$12.72		$18.82
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	400 lbs 34-0-0 @ $0.114 = 45.60	49.15
Flailing	50	7	1.50	7.43	6.28		13.71
Soil & Leaf Analysis		1	0.10			$1.00 per acre	1.00
Minor Element Spray	50	1	0.50	2.48	1.64	Borospray 5 lbs @ $0.80 = 4.00	8.12
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Sweeping, Picking & Hauling (custom)						$80.00 per acre	80.00
Processing, Drying & Marketing (custom)						950 lbs @ $0.15 19 sacks @ $0.65 = 154.85	154.85
Use of Pickup			1.50	7.72	4.28		11.99
			12.60	$63.55	$35.11		$413.10

VARIABLE CASH COSTS

Cultural Costs	$413.10
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$418.90

NON-VARIABLE CASH COSTS

Taxes	$61.00
Insurance	21.46
Interest on Operating Capital	26.18
Legal & Accounting	16.67
Total Non-Variable Cash Costs	115.31
	$534.21
2% Overhead	10.68
Total Cash Costs	$544.89
Expected Market Return: Year 16 Partial crop 950 lbs @ $0.85	807.59
Return to Operator Labour, Management and Land, Building & Equipment Investment	$262.61

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 17 - Per Acre Cost

Yield: 1100 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	5.00	$6.10	$12.72		$18.82
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.08	400 lbs 34-0-0 @ $0.114 = 45.60	49.15
Liming	50	1	0.50	2.48	1.08	2000 lbs @ $0.019 = 38.00	41.55
Flailing	50	7	1.50	7.43	6.28		13.71
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Sweeping, Picking & Hauling (custom)						$80.00 per acre	80.00
Processing, Drying & Marketing (custom)						1100 lbs @ $0.15 22 sacks @ $0.65 = 179.30	179.30
Use of Pickup			1.50	7.72	4.28		11.99
			12.50	$43.55	$34.54		$469.99

VARIABLE CASH COSTS

Cultural Costs	$469.99
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$475.79

NON-VARIABLE CASH COSTS

Taxes	$41.00
Insurance	31.46
Interest on Operating Capital	29.74
Legal & Accounting	16.67
Total Non-Variable Cash Costs	118.86
	$594.65
2% Overhead	11.89
Total Cash Costs	$606.54
Expected Market Return: Year 17 Partial crop 1100 lbs @ $0.85	$935.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	$328.46

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 1E - Per Acre Cost

Yield: 1200 lbs.

Location: Fraser Valley
Size: 30 acres 108 trees per acre 20' x 20' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	5.00	$6.10	$12.72		$18.82
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1	0.50	2.48	1.06	400 lbs 34-0-0 @ $0.114 = 45.60	49.15
Flailing	50	7	1.50	7.43	6.28		13.71
Minor Element Spray	50	1	0.50	2.48	1.64	Borospray 5 lbs @ $0.80 = 4.00	8.12
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Sweeping, Picking & Hauling (custom)						$80.00 per acre	80.00
Processing, Drying & Marketing (custom)						1200 lbs @ $0.15 24 sacks @ $0.65 = 195.60	195.60
Use of Pickup			1.50	7.72	4.28		11.99
			12.50	$43.55	$35.11		$452.85

VARIABLE CASH COSTS

Cultural Costs		$452.85
R & M on Buildings & Appurtenances		5.80
Total Variable Cash Costs		$458.65

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	28.67	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		117.79
		$576.44
2% Overhead		11.53
Total Cash Costs		$587.97
Expected Market Return: Year 19 Partial crop 1200 lbs @ $0.85		1020.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$432.03

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 19 - Per Acre Cost

Yield: 1300 lbs.

Location: Fraser Valley
Size: 30 acres 109 trees per acre 20' x 20' spacing
Hired Labour Rate: $5.57/hr. (includes statutory benefits & W.C.B. costs)

OPERATION	H.P.	Times	Labour (Hrs) Hired	Labour (Hrs) Operator	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1		5.00	$6.10	$12.72		$18.82
Herbicide Spraying	50	2		1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1		0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Fertilizing	50	1		0.50	2.48	1.08	400 lbs 34-0-0 @ $0.114 = 45.60	49.15
Flailing	50	7		1.50	7.43	6.28		13.71
Orchard Floor Maintenance	50	1		2.00	9.91	4.20		14.11
Tree Removal		1	14.00	14.00				
Sweeping, Picking & Hauling (custom)							$80.00 per acre	80.00
Processing, Drying & Marketing (custom)							1300 lbs @ $0.15 26 sacks @ $0.65 = 211.90	211.90
Use of Pickup				1.50	7.72	4.28		11.99
			14.00	26.00	$41.07	$33.47		$461.04

VARIABLE CASH COSTS

Cultural Costs		$461.04
R & M on Buildings & Appurtenances		5.80
Total Variable Cash Cos		$466.84

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	29.18	
Legal & Accounting	16.67	
Total Non-Variable Cash		118.30
		$585.14
2% Overhead		11.70
Total Cash Costs		$596.84
Expected Market Return: Year 19 Partial crop 1300 lbs @		1105.00
Return to Operator Labour, Management and Land, Building & Equipment Investment		$508.16

1984 WALNUT ORCHARD ESTABLISHMENT - YEAR 20 and Following Years - Per Acre Cost

Location: Fraser Valley
Size: 30 acres 54 trees per acre 20' x 40' spacing

OPERATION	H.P.	Times	Operator Labour (Hrs)	Fuel & Oil	R & M	Materials	Total
Pruning & Removal	12	1	4.00	$4.88	$10.18		$15.05
Herbicide Spraying	50	2	1.00	4.96	3.28	Paraquat 2 L @ $18.25 = 36.50	44.74
Insect Spraying	50	1	0.50	2.48	1.64	Basudin 2.5 lbs @ $5.00 = 12.50	16.62
Disease Spraying	50	1	1.00	4.96	3.28	Fixed Copper 8 lbs @ $2.50 = 20.00	28.24
Fertilizing	50	1	0.50	2.48	1.08	500 lbs 34-0-0 @ $0.114 400 lbs 0-0-60 @ $0.111 = 101.40	104.95
Liming (every 4th yr)	50	1	0.13	0.62	0.27	1000 lbs @ $0.019 /4 = 4.75	5.64
Flailing	50	7	1.50	7.43	6.28		13.71
Minor Element Spray (every 2nd yr)	50	1	0.25	1.24	0.82	Borospray 5 lbs @ $0.80 /2 = 2.00	4.06
Orchard Floor Maintenance	50	1	2.00	9.91	4.20		14.11
Sweeping, Picking & Hauling (custom)						$80.00 per acre	80.00
Processing, Drying & Marketing (custom)						1500 lbs @ $0.15 30 sacks @ $0.65 = 244.50	244.50
Use of Pickup			2.00	10.29	5.70		15.99
			12.88	$49.24	$36.72		$587.60

VARIABLE CASH COSTS

Cultural Costs	$587.60
R & M on Buildings & Appurtenances	5.80
Total Variable Cash Costs	$593.40

NON-VARIABLE CASH COSTS

Taxes	$41.00	
Insurance	31.46	
Interest on Operating Capital	37.09	
Legal & Accounting	16.67	
Total Non-Variable Cash Costs		126.21
		$719.62

2% Overhead	14.39
Total Cash Costs	$734.01
Expected Market Return: Year 20 Full Crop 1500 lbs @ $0.85	1275.00
Return to Operator Labour, Management and Land, Building & Equipment Investment	$540.99

WALNUT ORCHARD SUMMARY

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Cash Income	$0.00	$0.00	$0.00	$0.00	$0.00	$100.00	$150.00	$225.00	$300.00	$375.00	$450.00	$467.50	$531.25	$595.00	$680.00
Cash Operating Expenses	943.31	200.26	189.42	189.42	189.42	250.18	225.74	230.35	254.80	230.35	230.35	474.23	522.63	499.65	508.52
Add: Depreciation	104.06	104.06	104.06	104.06	104.06	104.75	104.75	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69
Interest	0	125.68	177.28	233.78	297.05	367.91	442.65	517.43	594.16	674.04	751.57	829.41	943.75	1,069.96	1,200.92
Total Cash Outflow	1,047.37	430.00	470.76	527.26	590.53	722.84	773.14	864.47	965.65	1,021.08	1,098.61	1,420.33	1,583.07	1,686.30	1,826.13
Net Cash Flow	($1,047.37)	($430.00)	($470.76)	($527.26)	($590.53)	($622.84)	($623.14)	($639.47)	($665.65)	($646.08)	($648.61)	($952.83)	($1,051.82)	($1,091.30)	($1,146.13)
Discounted Cash Flow	($952.15)	($355.38)	($353.69)	($360.12)	($366.67)	($351.58)	($319.77)	($298.32)	($282.30)	($249.09)	($227.34)	($303.60)	($304.67)	($287.37)	($274.37)

	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Cash Income	$807.50	$935.00	$1,020.00	$1,105.00	$1,275.00	$1,275.00	$1,275.00	$1,275.00	$1,275.00	$1,275.00	$1,275.00	$1,275.00	$1,275.00	$1,275.00	$1,275.00
Cash Operating Expenses	544.89	686.54	587.97	596.84	734.01	734.01	734.01	734.01	734.01	734.01	734.01	734.01	734.01	734.01	734.01
Add: Depreciation	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69	116.69
Interest	1,338.46	1,481.56	1,633.94	1,792.17	1,960.25	2,144.57	2,351.00	2,582.20	2,841.15	3,131.17	3,456.00	3,819.80	4,227.26	4,683.61	5,194.73
Total Cash Outflow	2,000.04	2,284.79	2,338.60	2,505.70	2,810.95	2,995.27	3,201.70	3,432.90	3,691.85	3,981.87	4,306.70	4,670.50	5,077.96	5,534.31	6,045.43
Net Cash Flow	($1,192.54)	($1,269.79)	($1,318.60)	($1,400.70)	($1,535.95)	($1,720.27)	($1,926.70)	($2,157.90)	($2,416.85)	($2,706.87)	($3,031.70)	($3,395.50)	($3,802.96)	($4,259.31)	($4,770.43)
Discounted Cash Flow	($259.53)	($251.22)	($237.16)	($229.03)	($228.31)	($232.46)	($236.69)	($240.99)	($245.37)	($249.83)	($254.38)	($259.00)	($263.71)	($268.50)	($273.39)

Summed Net Present Value ($1,211.69)

1984 WALNUT ORCHARD
Cost per Acre - Okanagan & Kootenay

The costs of establishing and maintaining a walnut orchard in the Okanagan and Kootenay regions are somewhat higher than those for the Lower Fraser Valley. This is due mainly to the need for irrigation in these regions. Fuel and transportation costs are also slightly higher. Machinery and equipment are otherwise the same. Walnut varieties used in the Interior are also different from those used at the Coast. Broadview is used as main crops with Cascade as pollenizer.

A portable sprinkler irrigation system is assumed to cost $12,000. Depreciated over a 20 year period, the annual depreciation cost is $600. Water cost is calculated at $55 per acre.

Operator labour for irrigation is calculated at 3.13 hours per acre per year and repairs and maintenance on the system at 6.25 per acre.

In all other respects the enterprise will be similar to the Fraser Valley model. As a result, the costs associated with a 30 acre walnut orchard in the Okanagan and Kootenay regions are as follows:

1984 WALNUT ORCHARD

Size: 30 acres

	Costs/Acre		Market	Costs/Acre	
	Okanagan	Kootenays	Return	Okanagan	Kootenays
Year 1	$997.41	$997.41	$0.00	($997.41)	($997.41)
Year 2	245.84	245.84	0.00	($245.84)	($245.84)
Year 3	233.58	233.58	0.00	($233.58)	($233.58)
Year 4	233.58	233.58	0.00	($233.58)	($233.58)
Year 5	233.58	233.58	0.00	($233.58)	($233.58)
Year 6	308.48	308.48	100.00	($208.48)	($208.48)
Year 7	278.37	278.37	150.00	($128.37)	($128.37)
Year 8	284.06	284.06	225.00	($59.06)	($59.06)
Year 9	314.21	314.21	300.00	($14.21)	($14.21)
Year 10	284.06	284.06	375.00	$90.94	$90.94
Year 11	284.06	284.06	450.00	$165.94	$165.94
Year 12	535.56	539.06	467.50	($68.06)	($71.56)
Year 13	590.22	594.08	531.25	($58.97)	($62.83)
Year 14	564.27	567.96	595.00	$30.73	$27.04
Year 15	574.29	578.04	680.00	$105.71	$101.96
Year 16	615.36	619.38	807.50	$192.14	$188.12
Year 17	684.98	689.46	935.00	$250.02	$245.54
Year 18	664.01	668.35	1020.00	$355.99	$351.65
Year 19	674.03	678.43	1105.00	$430.97	$426.57
Year 20 +	805.92	813.29	1275.00	$469.08	$461.71

POOR

QUALITY

ORIGINAL